SANTA CLARA VALLEY WATER DISTRICT

HYDROLOGY

DOCUMENTATION FOR THE SOUTH FLOOD CONTROL ZONE

Prepared by

A. D. Saah, P.E.
Associate Civil Engineer
Project Development Branch

Under the Direction of
Managements of Water Supply Planning
and
Design and Construction Units

July 1978

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TABLE OF CONTENTS

Page

GENERAL INFORMATION-- ii
  Llagas Creek Hydrology-- iii
  Uvas Creek Hydrology-- iii

SUMMARY OF METHODS AND PROCEDURES------------------------------------ 1
  General-- 1
  Regional Regression Analysis-- 2
  Gaged and Ungaged Locations--- 3
  Techniques Used for Developing Flood Hydrographs-------------------- 3
  Regulated Watersheds-- 4
  Urban Hydrology--- 5
  Upper 80 Percent Confidence Limits---------------------------------- 6
  Previous Studies and Coordinated Results---------------------------- 6
  Further Information--- 7

ACKNOWLEDGEMENTS-- 8

LLAGAS CREEK DETERMINATION OF DESIGN FLOWS--------------------------- 1-0

UVAS CREEK HYDROLOGY DETERMINATION OF DESIGN FLOWS------------------- 2-0

REFERENCES-- 2-3

GENERAL INFORMATION

This report summarizes the work completed on the hydrology within the Santa Clara Valley Water District's South Flood Control Zone. Presented in the report are recommended design flows for Llagas and Uvas Creeks and each of their respective tributaries. They are divided into several hydrologic studies each containing a table of contents, a general information about the physical and hydro-meteorological features of the basin, and a discussion of the procedures followed. This last item includes the analysis of recorded data, as well as recorded and reconstituted data. It also includes a comparative analysis of the regional and site specific statistics.

The choice of the final design flows is based on findings from the above results. It is the intent of this report, as well as other similar reports, to present a documentation of the hydrologic assumptions made together with the steps taken in the mathematical calculations. Each creek was originally treated separately. Inasmuch as the study has been combined in terms of flood control zones, some redundancy is to be expected.

The following is a list of the tributaries analyzed in these studies:

Llagas Creek Hydrology

- Alamias Creek
- Church Creek
- Corralitos Creek
- Day Creek
- Dexter Creek
- Edmundson Creek
- E. Little Llagas Creek
- Foothill Creek
- Jones Creek
- Lions Creek
- Live Oak Creek
- Llagas Creek
- Machado Creek
- Madrone Channel
- Maple Creek
- Miller Slough
- Ortega Creek
- Panther Creek
- Princevale Drain
- Ronan Diversion
- San Martin Creek
- San Ysidro Creek
- Skillet Creek
- Tennant Creek
- West Branch Llagas Creek
- West Little Llagas Creek

Uvas Creek Hydrology

- Bodfish Creek
- Croy Creek
- Gavilan Creek
- Little Arthur Creek
- Tar Creek
- Tick Creek
- Uvas Creek
- Whitehurst Creek

SUMMARY OF METHODS AND PROCEDURES

General

The District has established its flood protection criterion for watershed areas greater than four square miles based on flows which has a 1% chance of being equaled or exceeded in any one year. For watershed areas between one and four square miles the criterion is the 2% flood and for watershed areas between 360 acres and one square mile it is the 4% flood.

The accompanying reports represent the 1977-78 update of the design flood flows for use in the design of flood control facilities in Santa Clara County. They present documentation for the calculation of the 1% and 10% design flood flows. Other design values (2% and 4%) are not presented herein; they could be obtained upon request. These values were calculated using the District's methods and procedures as augmented and modified by the recommendations of the panel of expert hydrologists* convened to review the methods in 1976 (Ref. 8). It was assumed in the derivation of these design flows that the channel system is free from major constrictions or significant flood storage (reservoirs are handled separately) and that the floodwaters at the design level are completely contained within channel banks or relatively narrow floodway limits.

The District's method of determining the design peaks and volumes of floods utilized all available sources of information to derive the most accurate values possible. In general, this method began with the use of Regional Regression Equations to compute peaks and volumes. These peaks and volumes were compared with the results of an analysis of reliable recorded streamflow data when such exist. The values were also compared with the results of a rainfall-runoff model before the final "design flow" classification is given. Where design flows are presently affected by reservoirs or by urbanization, special analyses accounting for their effects were performed. Finally, the design flows were compared with the results of other studies and with previously determined design flows. The results of such comparison are useful to further define the design values.

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*The panel members were Leo Beard, Dave Dawdy, Neil Grigg, Douglas L. James and Vujica Yevjevich. Their report, "Review of Basic Hydrology Methodology for Flood Control" Santa Clara Valley Water District, 1976, is available from the District library.

Hydrographs were derived utilizing the Corps of Engineers' standard project storm and the Clark Synthetic Unit Hydrograph technique. The peaks and volumes of these hydrographs were then adjusted to agree with those values derived from regional or local statistics. The flood hydrographs obtained this way are considered representative for use in the design of most flood control facilities. However, where flood traps (small volume peak skimmers) are being considered, a sensitivity analysis of the design relative to hydrograph shape should be conducted.

Following is a more detailed disucssion of these methods. Full documentation of the analyis of each stream is available in separate reports.

Regional Regression Analysis

The backbone of the District's hydrology is the application of the Regional Regression Equations (1976) for the determination of flood peaks and volumes. These equations were obtained by analyzing recorded streamflow data (peak flows and their respective volumes) from stations within and outside the District. The data were correlated, expanded, and the resultant statistics adjusted to obtain the dependent variables (mean, standard deviation, and 1% flow). These statistics were then regressed to the physical characteristics of their respective basins (independent variables) by means of a mathematical process called Multiple Linear Regression. The regression equations chosen had minimal standard errors of estimates and maximum determination coefficients. These equations are applicable to all unurbanized locations within the District to generate statistics for the determination of design flood peaks and volumes.

Gaged and Ungaged Locations

At gaged locations the statistics from the regression equations were compared with the site-specific statistics obtained from recorded data when such data were usable. The statistics from recorded data were obtained using the methods presented in the Water Resources Council Bulletin #17 (Ref. 2). If there were significant differences between the regional and site-specific results, then new statistics (weighted with respect to their respective standard errors) were calculated. These statistics, together with a Pearson Type III distribution a -0.6 regional skew coefficient or a weighted one, were used to determine the frequency regime.

At ungaged and rural locations, the results of the regression equations are considered to provide the best available information and, hence, are to be used for analysis and design.

Techniques Used for Developing Flood Hydrographs

Pattern runoff hydrographs are obtained from rainfall using Clark's Synthetic Unit Hydrograph method (as developed by the Corps of Engineers' HEC-1 computer program). This rainfall runoff transformation involves the determination of loss rates, synthetic unit hydrograph parameters, spatial distribution of rainfall over the watershed and temporal distributions of rainfall rates within one storm. The first two items are usually obtained from projections of optimized results of recorded rainfall and its respective runoff data. The averaging of rainfall over the basin is usually done by the regular Theissen weighing operations. The temporal distribution is determined generally by using the Corps of Engineers' Standard Project Storm for Northern California.

If the peaks and volumes of the pattern hydrographs obtained are drastically different from the regional or site-specific results, then the reasons were investigated and, if justified, further adjustments were made. In this study, the rainfall-runoff-generated peaks and volumes are found to generally agree with regional or statistical values when average rainfall and area configurations were present. To avoid the uncertainties inherent in the rainfall-runoff transformation, the peaks and volumes generated from this transformation are balanced by regional values.

The balanced hydrographs obtained above are then combined with other hydrographs and routed downstream. The routing was done using linear methods (e.g., Muskingum by computing k when x = 0) if routing through channel system, or nonlinear methods (modified Pulse) if significant storage is available.

Rainfall distribution, time of concentration and the various routing operations are the items that define the shape of pattern hydrographs, with rainfall distribution being the foremost. The effect of the shape of these hydrographs, given constant peaks and volumes, may become significant when flow trapping is being considered as a flood protection measure. An in-depth analysis of the shape was not attempted as a part of this work.

Regulated Watersheds

In regulated watersheds, regulated by reservoirs, the design flows are assumed as inflows to the reservoirs. The initial storage levels of the reservoirs that coincide with the design flows of certain frequencies are computed from the stage-duration frequency (S.D.F.) analysis of daily recorded reservoir volumes. The Corps of Engineers' Coincidental Frequency Analysis (discussed in Leo Beard's "Statistical Methods") procedures were used to solve this compounded probability problem. At most reservoirs, the S.D.F. curves after 1968 were used because, since that time, the reservoirs have retained more water in storage longer to enhance recreation.

Urban Hydrology

The above procedures are applicable mainly to rural watersheds. For urban watersheds, the methodology changes and the regional regression equations do not apply.

Urban hydrology deals with the effects due to two major changes in the watershed, namely:

1. Increased imperviousness
2. Channelization

The increase in imperviousness is caused by rooftops, streets, parking lots, driveways, and other man-made ground surface cover. Channelization includes the flow of water in gutters, storm drains, improved channels, etc. An increase in the imperviousness tends to reduce the loss rates and increase the runoff volumes and peaks, while channelization may either increase or decrease the peaks. It depends on the magnitude of the flood and the storage-discharge capacity of the various channels or storm drain systems that carry the flood.

To determine the effect of increased imperviousness, the urban area of every watershed was divided into subareas tributary to the major storm drains. These subareas are then transformed into equivalent rectangular subareas where the length is equal to the length of an equivalent street. The ratio of imperviousness (which is a measure of land use) is then used to subdivide this equivalent subarea into two sub-subareas of pervious and impervious parts.

In order to calculate the separate inflow hydrographs from the two sub-subareas, the unit hydrograph procedure was employed using separate times of concentration for both the pervious and impervious parts. The routing coefficient is calculated from the length and width of these areas. The loss rates, which are the third set of parameters needed for the computation of the one percent flood hydrograph, are assumed to be 30 percent for the pervious part and five percent for the impervious part. Since most of the floodwater from urban areas is conveyed to flood control channels by the storm drain system, these hydrographs are routed through the storm drain system utilizing the modified Pulse routing method. This routing requires storage-discharge curves for the system of streets, gutters, manholes, and storm drains. Two actual urban areas, one of low-density residential and another of high-density residential and commercial, were used to develop equivalent generalized storage facilities and storage-discharge curves. The resultant curves were transformed to reflect unit areas, and then compared with each other. Since the two curves are very similar, an average smooth curve was chosen and used.

Because most of the urban area in Santa Clara Valley is in the flatland and similar storm drain design criteria were used throughout, it is assumed that the unit storage-discharge curve that was obtained from the above study is applicable to all the urban areas in the Valley.

The above method is detailed in a paper presented before the National Symposium on Urban Hydrology in 1976.

Upper 80 Percent Confidence Limits

As a District policy, the upper 80 percent confidence value for the 1% design flow rate is used as one input to define freeboard criteria. It is defined as the value at which there is a 90 percent chance that the design flow is equal to less than the given value. It relates to the standard errors associated with the statistical inferences of information about populations from very limited samples. These values are calculated using the Non-Central Student "t" Distribution as shown in the Water Resources Council Bulletin #17.

Previous Studies and Coordinated Results

As a part of the design flood flow determination procedure, all available hydrologic analyses done on any watershed were reviewed and considered.

These previous analyses were sometimes the result of an in-house effort and other times the result of efforts of other agencies.

Because of the nature of random events, especially in the case of small samples, the results obtained from previous analysis were not necessarily congruent with the new values. Therefore, an in-depth search of the adequacy of the various results and methods involved was done.

As a result of this study, some of the adopted values were supported not only by District-developed methods and techniques but also by those of the Corps of Engineers and others.

Further Information

The attached information is only a summary report of that available. Additional information, available upon request from the Hydrologic Library, is listed below:

1. Hydrographs, either plotted or numerical, at all locations.

2. Runoff from intermediate areas such as urban runoff.

3. Recorded streamflow data at most gaged locations.

4. Stochastically estimated data at most gaged stations.

5. A full spectrum of statistical analysis of the above data which include the investigation of outliers, the incorporation of historic flows, and the adjustment of statistics and probabilities.

6. Statistical analysis of rainfall data on all gaged locations.

7. Complete descriptions and documentation of computations done for other streams in the County.

8. Other supporting documents of the methods like the 1976 Panel of Experts Report, the 1976 Regional Regression Study, Paper on Urban Hydrology and Reports by Zone, discussing the hydrology in detail.

ACKNOWLEDGEMENTS

E. S. Watson, Division Engineer, was very instrumental in directing this work and reviewing this report.

Morgan Kolyn compiled the data needed for this report and drafted the original text.

LLAGAS CREEK

DETERMINATION OF DESIGN FLOWS

CONTENTS

Page

GENERAL INFORMATION--- 1-2
  Climate and Hydrologic Characteristics of the Basin--------------- 1-2

DISCUSSION OF PROCEDURES-- 1-3
  Basin Characteristics and 1% Regional Flows----------------------- 1-3
  Recorded Data and Application of Regional Regression Equations---- 1-4
  Chesbro Reservoir Enlargement------------------------------------- 1-7
  Initial Reservoir Level - Coincident Frequency-------------------- 1-8

PREVIOUS STUDIES-- 1-16

CONCLUSION-- 1-16

FIGURES

Figure

1-1 Upper Llagas Creek Drainage Area-------------------------- 1-5

1-2 Llagas Creek Drainage Area-------------------------------- 1-5a

1-3 Chesbro Reservoir Storage - Duration Curve---------------- 1-15

1-4 Exceedence Frequency Curves at Llagas Creek U/S Pajaro River-- 1-31

TABLES

Table

1-1 1977 SCVWD 1% Flows for Existing Chesbro Reservoir, Full Storage--- 1-9

1-2 1977 SCVWD 1% Flows for Enlarged Chesbro Reservoir, Full Storage--- 1-12

1-3 Comparative 1% Design Flows, Llagas Creek Watershed-------- 1-17

1-4 1977 SCVWD 1% Design Flows for Existing Chesbro Reservoir, Initial Storage------------------------------ 1-19

1-5 1977 SCVWD 1% Design Flows for Enlarged Chesbro Reservoir, Initial Storage------------------------------ 1-22

1-6 1977 SCVWD 10% Design Flows for Existing Chesbro Reservoir, Initial Storage------------------------------ 1-25

1-7 1977 SCVWD 10% Design Flows for Enlarged Chesbro Reservoir, Initial Storage------------------------------ 1-28

GENERAL INFORMATION

Llagas Creek drains part of the southern Santa Clara Valley from Chesbro Dam to the Pajaro River. The watershed (Figures 1-1 and 1-2) is approximately 14 miles long by 6 miles wide and is roughly bisected along its length by Highway 101. Urbanization in the northern half of the watershed is centered at Morgan Hill while urbanization in the southern half is concentrated at Gilroy. Llagas Creek flows in a generally southeasterly direction while its tributaries flow into it from the Santa Cruz Mountains to the west and from the Diablo Range to the east.

The average slopes of these tributaries range from 50 to 600 feet/mile. The slope of the valley floor is roughly constant at 15 feet/mile. The existing capacity of the channel varies from about 200 cfs at the confluence with small tributaries to about 16,000 cfs at the Pajaro River confluence.

Climate and Hydrologic Characteristics of the Basins

The Llagas Basin has warm, dry summers and mild winters. The wet season lasts from October to May, but the majority of the precipitation occurs from December through March. The west side of the study area receives a mean annual precipitation which varies from about 18 inches to about 45 inches. The majority of the east side area receives a mean annual precipitation of about 18 inches. The distribution of vegetative cover follows the mean annual precipitation pattern. It ranges from forest cover on top of the Santa Cruz Mountains, where rainfall is highest, to pasture land at lower elevations.

DISCUSSION OF PROCEDURES

Basin Characteristics and 1% Regional Flows

The Llagas Creek Watershed was divided into two major watersheds, Llagas rural, which includes subareas A, B, C, E... O, Q, S, T, U, V; and Llagas urban, which includes subareas D, P, and R (Figures 1-1 and 1-2). Urban subareas comprise less than 10% of the entire watershed area and their effect on the flow regime is minimal. Yet urban areas were treated based on District's method of urban hydrology. The partial list below considers only typical rural subareas and their basin characteristics.

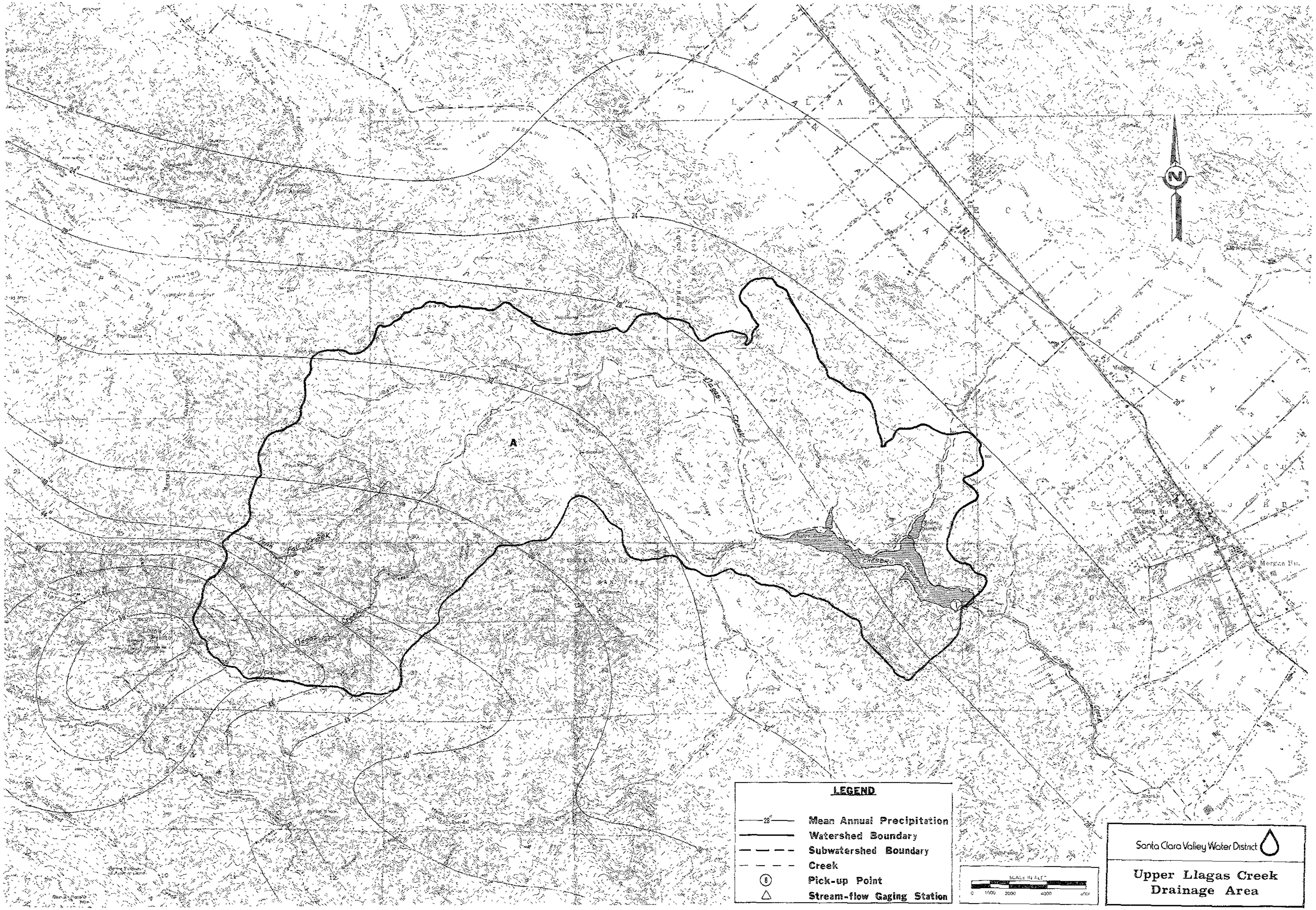
Location	Sub-Areas	Drainage Area (Sq.Mi.)	M.A.P. (in.)	Lls ($mi^2/ft/ft^{1/2}$)	T_c (Hrs.)
Llagas Creek U/S Chesbro Res.	A	19.2	33.0	781.3	3.9
Llagas Creek U/S Machado Creek	B_1	3.35	26.6	68.6	1.60
Llagas Creek U/S E. Little Llagas Crk.	F	2.24	22.0	137.0	2.8
Corralitos Creek U/S Tennant Creek	H_2	1.27	17.5	13.3	.4
Skillet Creek U/S Rucker Creek	K_1	1.31	18.0	34.1	.9
West Branch Llagas Crk. U/S Lions Crk.	N	5.91	23.0	385.2	1.4
Day Creek U/S Lions Creek	O_2	.93	22.5	16.0	.7
Ortega Creek U/S Jones Creek	T_1	2.58	15.5	30.5	.9
San Ysidro U/S Jones Creek	U	4.26	17.0	88.6	1.3

Recorded Data and Application of Regional Regression Equations

Inherent in the District hydrology method are checking procedures that utilize additional data wherever available. Systematic records, historic data and stochastically-generated data are used. Following is a discussion of these procedures and their application to Llagas Creek.

There is one streamgage (USGS #1535) in the 84.5 square mile drainage area of Llagas Creek downstream of Chesbro Dam. The gage is maintained by the United States Geological Survey and is located on Llagas Creek 0.3 miles downstream from Chesbro Dam. Chesbro Dam construction was completed in 1955, four years after the streamgage was installed, so that the gage record includes four years of unregulated flow. The mean of the recorded maximum annual flows for these four years compared favorably with the mean predicted by the 1976 regional equations. The results are as follows:

Yr.	Recorded Q (cfs)	Recorded Log Q (cfs)	Recorded Mean Log Q/Q	Predicted Mean Log Q/Q (cfs)
1952	2,760	3.441	2.949/890	2.925/845
1953	1,500	3.176		
1954	609	2.785		
1955	249	2.396		



Upper Llagas Creek Drainage Area

Figure 1-1

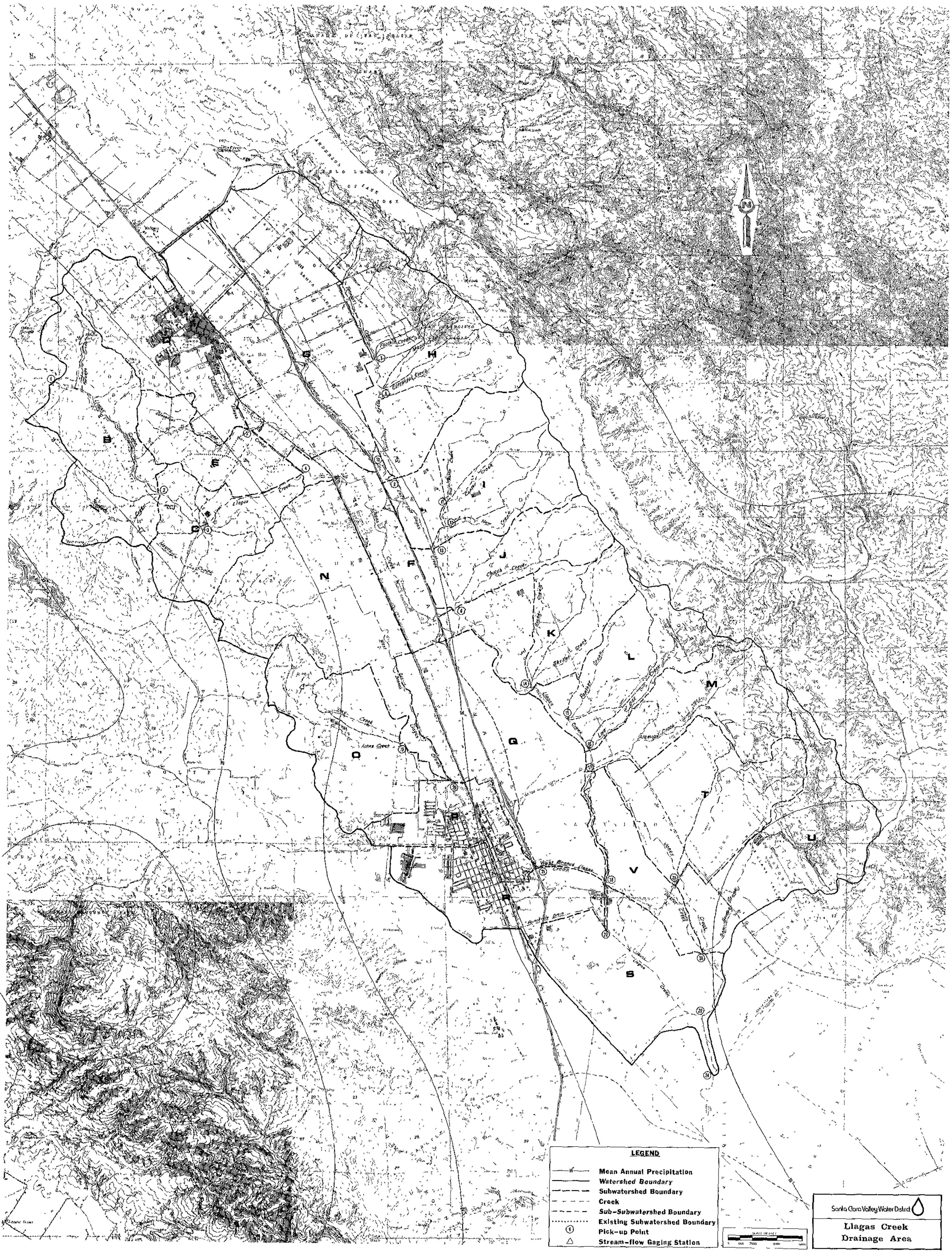

LEGEND
Mean Annual Precipitation
Watershed Boundary
Subwatershed Boundary
Creek
Sub-Subwatershed Boundary
Existing Subwatershed Boundary
Pick-up Point
Stream-flow Gaging Station
SCALE IN FEET
0
1000
2000
4000
6000
Santa Clara Valley Water District
Llagas Creek
Drainage Area

Figure 1-2

Further calculations of the statistics of the recorded data and adjustment of frequency statistics based on nearby streamgages of longer record were carried out, but were found to be unreliable due to the standard deviation's sensitivity to the short Llagas record and to the bias involved in the regulated recorded flow after the reservoir was built. However, the results above indicate that the prediction by 1976 regression is acceptable at the stream gage location.

Chesbro Reservoir Enlargement

The existing Chesbro Reservoir serves primarily as a storage distribution facility and has a maximum conservation storage capacity of 7,500 acre-feet out of a total pool capacity of 8,086 acre-feet. This dam was constructed in 1955 and has performed satisfactorily. According to the present schedule, bids will be requested for constructing the enlargement of Chesbro Reservoir to add 3,570 acre-feet of flood retention storage in early 1978. (Reference 4) The enlarged reservoir will not provide for any increase in the existing conservation storage capacity of 7,500 acre-feet. The added surcharge storage will be used for flood mitigation.

To assess the flood reduction obtained from the reservoir enlargement, this study provides flows with both the existing reservoir storage capacity and with the enlarged reservoir storage capacity.

On one hand, flows obtained with the existing reservoir condition exclude planned diversions at West Little Llagas Creek upstream of Llagas and at Ronan Diversion near Gilroy, and include only the existing storm drain configurations in Morgan Hill and Gilroy. These flows were basically used in the Federal Insurance Administration determination of flood plans.

On the other hand, flows obtained with the enlarged reservoir include the two planned diversions, installation of planned storm drains in the Cities of Morgan Hill and Gilroy and completely contained flows within the banks of flood control facilities. The flows obtained based on the above stated conditions are recommended for District flood control design.

With 8,086 acre-feet as the full initial storage volume in the existing and enlarged reservoirs, the one percent flow rates for the existing reservoir are tabulated in Table 1-1, and the one percent flow rates for the enlarged reservoir are tabulated in Table 1-2.

Initial Reservoir Level - Coincident Frequency

Chesbro Reservoir is operated as a water conservation facility, but it provides incidental flood protection since it could be less than full when a large storm occurs. Even a full reservoir will attenuate a flood peak to some degree.

Because there is a very good chance (more than 90%, Figure 1-3) that the reservoir would not be full at the time the design flows occur, it was necessary to determine an initial reservoir level which would account for the compounded probabilities between the incoming flood and initial storage. This would give a realistic value for an outflow which would have a percentage chance equal to that of the inflow. The procedure followed is documented in the Corps of Engineers' Statistical Methods In Hydrology. The results for Chesbro, considering storage data between 1963 and 1976, indicate that the initial existing and enlarged 1% reservoir storages should each be 6,000 acre feet (74% of capacity).

As indicated in Figure 1-3, there is a slight trend in keeping the reservoir at higher storage elevations. The 1955-1976 curve shows that the reservoir was kept emptier than the curves generated from data after 1963. This later curve was used in the determination of coincidental initial reservoir storage.

TABLE 1-1

1977 1% Flows, Llagas Creek
Chesbro Full Storage 8086 AF
Existing Reservoir

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	1	6548	4842	2984	1492	19.20	Llagas U/S Chesbro Dam
ROUTED TO	1	4825	4396	2753	1613	19.20	Llagas D/S Chesbro Dam
ROUTED TO	2	4723	4356	2748	1613	19.20	
HYDROGRAPH AT	2	1451	870	508	255	3.35	
ROUTED TO	2	1451	870	508	255	3.35	
2 COMBINED	2	5218	4869	3171	1868	22.55	Llagas U/S Machado Confl.
HYDROGRAPH AT	2	654	354	206	107	1.34	Machado U/S Llagas Confl.
ROUTED TO	2	654	354	206	107	1.34	
2 COMBINED	2	5491	5087	3341	1975	23.89	Llagas D/S Machado Confl.
ROUTED TO	3	5381	5073	3340	1975	23.89	
HYDROGRAPH AT	3	369	178	103	54	.59	
ROUTED TO	3	369	178	103	54	.59	
2 COMBINED	3	5465	5179	3426	2029	24.48	Llagas U/S Hayes Confl.
ROUTED TO	4	5432	5159	3423	2029	24.48	
HYDROGRAPH AT	4	1359	802	465	233	3.03	
ROUTED TO	4	1359	802	465	233	3.03	
2 COMBINED	4	6062	5755	3018	2262	27.51	Llagas U/S W. L. Llagas Confl.
ROUTED TO	6	5775	5630	3805	2262	27.51	
HYDROGRAPH AT	6	1126	620	349	178	2.24	
ROUTED TO	6	1126	620	349	178	2.24	
2 COMBINED	6	6415	6065	4098	2440	29.75	Llagas U/S E. L. Llagas Confl.
HYDROGRAPH AT	5	500	301	188	91	1.00	
ROUTED TO	5	140	139	126	91	1.00	
HYDROGRAPH AT	5	1421	999	561	271	4.03	
2 COMBINED	5	1556	1129	679	362	5.03	W. L. Llagas U/S Edmundson Confl.
HYDROGRAPH AT	5	566	290	167	87	1.01	
ROUTED TO	5	566	290	167	87	1.01	Edmundson U/S W. L. Llagas Confl.
2 COMBINED	5	1892	1415	846	449	6.04	
ROUTED TO	9	1827	1405	844	450	6.04	
HYDROGRAPH AT	9	1308	721	420	216	3.07	
ROUTED TO	9	1309	721	420	216	3.07	
2 COMBINED	9	3135	2122	1263	665	9.11	
HYDROGRAPH AT	10	2068	1222	699	350	5.09	Madrone Channel U/S E. L. Llagas
ROUTED TO	10	2068	1222	699	350	5.09	
ROUTED TO	9	1857	1221	699	350	5.09	
2 COMBINED	9	4557	3339	1962	1016	14.20	E. L. Llagas U/S Corralitos Confl.
HYDROGRAPH AT	7	709	366	206	106	1.56	Tennant U/S Foothill Confl.
ROUTED TO	7	709	366	206	106	1.56	
HYDROGRAPH AT	7	252	110	62	34	.43	Foothill U/S Tennant Confl.
ROUTED TO	7	252	110	62	34	.45	
2 COMBINED	7	856	473	268	140	1.99	Tennant D/S Foothill Confl.
ROUTED TO	8	827	473	268	140	1.99	
HYDROGRAPH AT	8	338	157	87	45	.63	Maple U/S Tennant Confl.
ROUTED TO	8	338	157	87	45	.63	
2 COMBINED	8	1045	626	354	186	2.62	Tennant D/S Maple Confl.
HYDROGRAPH AT	8	558	281	159	83	1.27	Corralitos U/S Tennant Confl.
ROUTED TO	8	558	281	159	83	1.27	
2 COMBINED	8	1573	906	513	268	3.89	Corralitos D/S Tennant Confl.
ROUTED TO	9	1438	905	513	268	3.89	
HYDROGRAPH AT	9	861	447	248	128	1.74	
ROUTED TO	9	861	447	248	128	1.74	
2 COMBINED	9	2182	1351	761	397	5.63	Corralitos U/S E.L. Llagas Confl.

TABLE 1-1(Continued)

2 COMBINED	9	6739	4677	2718	1413	19,83	E. L. Llagas D/S Corralitos Confl.
ROUTED TO	13	6365	4664	2717	1413	19,83	
HYDROGRAPH AT	11	667	345	195	101	1,59	
ROUTED TO	11	667	345	195	101	1,59	San Martin U/S Center Confl.
ROUTED TO	12	602	345	195	101	1,59	
HYDROGRAPH AT	12	518	252	142	75	1,05	
2 COMBINED	12	1002	583	333	174	2,64	
ROUTED TO	13	984	583	333	174	2,64	San Martin U/S New Confl.
HYDROGRAPH AT	13	586	285	159	84	1,10	
2 COMBINED	13	1396	834	477	249	3,74	
HYDROGRAPH AT	13	493	238	134	70	,92	San Martin U/S E. L. Llagas Confl.
2 COMBINED	13	1725	1049	602	315	4,66	E. L. Llagas (Local) U/S San Martin
2 COMBINED	13	7438	5678	3312	1728	24,49	
ROUTED TO	6	7363	5669	3310	1728	24,49	E. L. Llagas D/S. San Martin Confl.
2 COMBINED	6	13778	11314	7206	4168	54,24	
HYDROGRAPH AT	6	806	416	234	122	1,75	
ROUTED TO	6	806	416	234	122	1,75	Church U/S Llagas Confl.
HYDROGRAPH AT	6	466	229	129	67	,93	
ROUTED TO	6	466	229	129	67	,93	E. L. Llagas (Local) U/S Llagas
2 COMBINED	6	1272	644	363	189	2,68	
2 COMBINED	6	14398	11887	7545	4357	56,92	
ROUTED TO	14	13820	11827	7534	4357	56,92	Llagas D/S E. L. Llagas Confl.
HYDROGRAPH AT	14	638	323	180	93	1,31	
ROUTED TO	14	638	323	180	93	1,31	Skillet U/S Rucker Confl.
HYDROGRAPH AT	14	498	241	134	70	,93	
ROUTED TO	14	498	241	134	70	,93	
2 COMBINED	14	1136	564	314	164	2,24	Rucker U/S Llagas Confl.
HYDROGRAPH AT	14	711	354	199	104	1,37	
ROUTED TO	14	711	354	199	104	1,37	Llagas (Local) U/S Rucker Confl.
2 COMBINED	14	1847	913	513	268	3,61	
2 COMBINED	14	14518	12588	8002	4625	60,53	
ROUTED TO	15	14404	12580	8001	4625	60,53	Llagas U/S Rucker Confl.
HYDROGRAPH AT	15	621	318	180	93	1,43	
ROUTED TO	15	621	318	180	93	1,43	Panther U/S Llagas Confl.
2 COMBINED	15	14660	12847	8166	4718	61,96	Llagas D/S Panther Confl.
ROUTED TO	16	14636	12838	8165	4718	61,96	
HYDROGRAPH AT	16	470	310	177	91	1,33	
ROUTED TO	16	470	310	177	91	1,33	Live Oak U/S Llagas Confl.
HYDROGRAPH AT	16	328	147	82	44	,54	
ROUTED TO	16	328	147	82	44	,54	Llagas (local) U/S Live Oak Confl.
2 COMBINED	16	797	456	259	135	1,87	
2 COMBINED	16	14914	13189	8397	4853	63,83	
ROUTED TO	17	14912	13185	8396	4853	63,83	Llagas D/S Live Oak Confl.
HYDROGRAPH AT	17	1191	674	380	192	3,24	
ROUTED TO	17	1191	674	380	192	3,24	Alamias U/S Llagas Confl.
2 COMBINED	17	15434	13767	8747	5045	67,07	Llagas D/S Alamias Confl.

TABLE 1-1(Continued)

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	17	15434.	13767.	8747.	5045.	67.07	
ROUTED TO	18	15242.	13693.	8737.	5045.	67.07	
HYDROGRAPH AT	20	2457.	1528.	876.	437.	5.91	
ROUTED TO	20	2457.	1528.	876.	437.	5.91	W. Branch Llagas U/S Lions
HYDROGRAPH AT	19	495.	248.	141.	74.	0.93	
ROUTED TO	19	495.	248.	141.	74.	0.93	Day U/S Lions Confl.
ROUTED TO	20	407.	247.	141.	74.	0.93	
HYDROGRAPH AT	20	1535.	929.	528.	264.	3.82	
ROUTED TO	20	1535.	929.	528.	264.	3.82	Lions U/S W. Branch Llagas
2 COMBINED	20	1867.	1176.	669.	337.	4.75	
2 COMBINED	20	3621.	2684.	1541.	774.	10.65	
ROUTED TO	21	3340.	2658.	1537.	774.	10.66	W. Branch Llagas D/S Lions Confl.
HYDROGRAPH AT	21	1442.	806.	465.	238.	3.53	
ROUTED TO	21	1442.	806.	465.	238.	3.53	Ronan Diversion U/S W. Branch Llagas
2 COMBINED	21	4540.	3462.	2002.	1013.	14.19	
HYDROGRAPH AT	21	236.	137.	85.	41.	0.49	
HYDROGRAPH AT	21	275.	186.	103.	50.	0.80	
2 COMBINED	21	465.	321.	186.	91.	1.29	
ROUTED TO	21	211.	210.	179.	91.	1.29	
2 COMBINED	21	4748.	3669.	2180.	1103.	15.48	Miller Slough (local) u/s W. Branch Llagas Confl.
ROUTED TO	18	4545.	3658.	2180.	1103.	15.48	W. Branch Llagas D/S Miller Slough
HYDROGRAPH AT	18	990.	518.	303.	160.	2.26	
ROUTED TO	18	990.	518.	303.	160.	2.26	
2 COMBINED	18	5102.	4172.	2483.	1263.	17.74	
2 COMBINED	18	20052.	17775.	11154.	6308.	84.81	W. Branch Llagas u/s Llagas Confl.
ROUTED TO	22	19969.	17748.	11154.	6308.	84.81	Llagas D/S W. Branch Confl.
HYDROGRAPH AT	22	353.	205.	127.	61.	0.74	
HYDROGRAPH AT	22	756.	508.	280.	135.	2.22	
2 COMBINED	22	1019.	709.	405.	196.	2.96	
ROUTED TO	22	359.	357.	327.	197.	2.96	
2 COMBINED	22	20326.	18102.	11480.	6505.	87.77	Princevale Drain U/s Llagas Confl.
ROUTED TO	23	20048.	17987.	11462.	6504.	87.77	Llagas D/S Princevale Drain
HYDROGRAPH AT	25	913.	471.	263.	134.	2.96	
ROUTED TO	25	913.	471.	263.	134.	2.96	Jones U/S Ortega Confl.
HYDROGRAPH AT	25	973.	513.	294.	152.	2.58	
ROUTED TO	25	973.	513.	294.	152.	2.58	Ortega U/S Jones Confl.
2 COMBINED	25	1593.	984.	557.	286.	5.54	
ROUTED TO	26	1522.	981.	557.	286.	5.54	Jones D/S Ortega Confl.
HYDROGRAPH AT	26	1581.	912.	512.	257.	4.26	
ROUTED TO	26	1581.	912.	512.	257.	4.26	San Ysidro U/S Jones Confl.
HYDROGRAPH AT	26	766.	381.	219.	116.	1.70	
ROUTED TO	26	766.	381.	219.	116.	1.70	Dexter U/S San Ysidro Confl.
2 COMBINED	26	2347.	1290.	731.	372.	5.96	
2 COMBINED	26	3651.	2269.	1286.	659.	11.50	
ROUTED TO	23	3351.	2262.	1285.	658.	11.50	San Ysidro D/S Jones, Dexter Confl.
2 COMBINED	23	21991.	19987.	12672.	7163.	99.27	
ROUTED TO	24	21950.	19931.	12671.	7163.	99.27	
HYDROGRAPH AT	24	1685.	1060.	616.	314.	4.38	
ROUTED TO	24	1685.	1060.	616.	314.	4.38	Llagas U/S Pajaro River Confl. (local)
2 COMBINED	24	22972.	20933.	13265.	7477.	103.65	Llagas Discharge to Pajaro River

Table 1-2

1977 1% FLOWS, LLAGAS CREEK
CHESBRO FULL STORAGE 8,086 AF
ENLARGED RESERVOIR

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	1	6548.	4842.	2984.	1492.	19.20	Llagas u/s Chesbro Dam
ROUTED TO	1	2759.	2687.	1985.	1223.	19.20	Llagas d/s Chesbro Dam
ROUTED TO	2	2744.	2672.	1983.	1219.	19.20	
HYDROGRAPH AT	2	1451.	870.	508.	255.	3.35	
ROUTED TO	2	1451.	870.	508.	255.	3.35	
2 COMBINED	2	3055.	2923.	2287.	1471.	22.55	Llagas u/s Machado Confl.
HYDROGRAPH AT	2	654.	354.	206.	107.	1.34	Machado u/s Llagas Confl.
ROUTED TO	2	654.	354.	206.	107.	1.34	
2 COMBINED	2	3267.	3033.	2419.	1577.	23.89	Llagas d/s Machado Confl.
ROUTED TO	3	3183.	3032.	2419.	1574.	23.89	
HYDROGRAPH AT	3	369.	178.	103.	54.	0.59	
ROUTED TO	3	369.	178.	103.	54.	0.59	
2 COMBINED	3	3290.	3120.	2487.	1628.	24.48	Llagas u/s Hayes Confl.
HYDROGRAPH AT	3	647.	355.	203.	99.	1.29	Hayes u/s Llagas Confl.
ROUTED TO	3	647.	355.	203.	99.	1.29	
2 COMBINED	3	3775.	3397.	2622.	1727.	25.77	Llagas d/s Hayes Confl.
ROUTED TO	4	3659.	3378.	2621.	1721.	25.77	
HYDROGRAPH AT	4	579.	298.	167.	81.	0.96	
ROUTED TO	4	579.	298.	167.	81.	0.96	
2 COMBINED	4	4028.	3609.	2731.	1802.	26.73	Llagas u/s W. L. Llagas Confl.
HYDROGRAPH AT	5	500.	301.	188.	91.	1.00	
HYDROGRAPH AT	5	1421.	999.	561.	271.	4.03	
2 COMBINED	5	1762.	1293.	746.	362.	5.03	
ROUTED TO	5	634.	630.	574.	362.	5.03	W.L. Llagas u/s Edmundson Confl.
HYDROGRAPH AT	5	566.	290.	167.	87.	1.01	Edmundson u/s W.L. Llagas Confl.
ROUTED TO	5	566.	290.	167.	87.	1.01	
2 COMBINED	5	1139.	873.	723.	449.	6.04	
ROUTED TO	4	1060.	872.	723.	450.	6.04	
2 COMBINED	4	5032.	4458.	3412.	2252.	32.77	
HYDROGRAPH AT	4	580.	297.	170.	88.	1.05	
ROUTED TO	4	580.	297.	170.	88.	1.05	
2 COMBINED	4	5612.	4723.	3540.	2340.	33.82	Llagas d/s W.L. Llagas Confl.
ROUTED TO	6	4946.	4622.	3528.	2326.	33.82	(@ Monterey Highway)
HYDROGRAPH AT	6	1126.	620.	349.	178.	2.24	
ROUTED TO	6	1126.	620.	349.	178.	2.24	
2 COMBINED	6	6007.	5147.	3786.	2504.	36.06	Llagas u/s E.L. Llagas Confl.
HYDROGRAPH AT	10	2068.	1222.	699.	350.	5.09	Madrone Channel u/s E.L. Llagas Confl.
ROUTED TO	10	2068.	1222.	699.	350.	5.09	
ROUTED TO	9	1857.	1221.	699.	350.	5.09	
HYDROGRAPH AT	9	1237.	675.	392.	202.	2.80	E.L. Llagas @ New 101
ROUTED TO	9	1237.	675.	392.	202.	2.80	
2 COMBINED	9	2660.	1897.	1091.	552.	7.89	E.L. Llagas u/s Corralitos Confl.
HYDROGRAPH AT	7	709.	366.	206.	106.	1.56	Tennant u/s Foothill Confl.
ROUTED TO	7	709.	366.	206.	106.	1.56	
HYDROGRAPH AT	7	252.	110.	62.	34.	0.43	Foothill u/s Tennant Confl.
ROUTED TO	7	252.	110.	62.	34.	0.43	
2 COMBINED	7	856.	473.	268.	140.	1.99	Tennant d/s Foothill Confl.
ROUTED TO	8	827.	473.	268.	140.	1.99	
HYDROGRAPH AT	8	338.	157.	87.	45.	0.63	Maple u/s Tennant Confl.
ROUTED TO	8	338.	157.	87.	45.	0.63	
2 COMBINED	8	1045.	626.	354.	186.	2.62	Tennant d/s Maple Confl.
HYDROGRAPH AT	8	558.	281.	159.	83.	1.27	Corralitos u/s Tennant Confl.
ROUTED TO	8	558.	281.	159.	83.	1.27	

TABLE 1-2(Continued)

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HYDROGRAPH AT      50     232.      102.      55.      27.      0.38
ROUTED TO          50     232.      102.      55.      27.      0.38
 2 COMBINED        50    1680.     1009.     568.     295.      4.27  Corralitos @ Middle Ave.
ROUTED TO           9    1634.     1008.     568.     295.      4.27
HYDROGRAPH AT       9     700.      361.     194.      94.      1.36
ROUTED TO           9     700.      361.     194.      94.      1.36
 2 COMBINED         9    2220.     1369.     762.     389.      5.63  Corralitos u/s E.L. Llagas Confl.
 2 COMBINED         9    4880.     3243.    1849.     941.     13.52  E.L. Llagas d/s Corralitos Confl.
ROUTED TO          13    4545.     3239.    1847.     941.     13.52
HYDROGRAPH AT      13     493.      238.     134.      70.      0.92
 2 COMBINED        13    4771.     3445.    1972.    1007.     14.44  E.L. Llagas u/s San Martin Confl.
HYDROGRAPH AT      11     667.      345.     195.     101.      1.59  San Martin u/s Center Confl.
ROUTED TO          11     667.      345.     195.     101.      1.59
ROUTED TO          12     602.      345.     195.     101.      1.59
HYDROGRAPH AT      12     518.      252.     142.      75.      1.05
 2 COMBINED        12    1002.      583.     333.     174.      2.64  San Martin u/s New Confl.
ROUTED TO          13     984.      583.     333.     174.      2.64
HYDROGRAPH AT      13     586.      285.     159.      84.      1.10
 2 COMBINED        13    1396.      834.     477.     249.      3.74  San Martin u/s E.L. Llagas Confl.
 2 COMBINED        13    5709.     4254.    2443.    1256.     18.18  E.L. Llagas d/s San Martin Confl.
ROUTED TO          51    5669.     4251.    2443.    1256.     18.18
HYDROGRAPH AT      51     275.      129.      70.      34.      0.49
ROUTED TO          51     275.      129.      70.      34.      0.49
 2 COMBINED        51    5815.     4376.    2513.    1290.     18.67  E.L. Llagas @ Church Ave.
ROUTED TO           6    5787.     4378.    2513.    1290.     18.67
HYDROGRAPH AT       6     273.      126.      67.      33.      0.44
ROUTED TO           6     273.      126.      67.      33.      0.44
 2 COMBINED         6    5883.     4496.    2579.    1323.     19.11  E.L. Llagas u/s Church Confl.
HYDROGRAPH AT       6     806.      416.     234.     122.      1.75  Church u/s E.L. Llagas Confl.
ROUTED TO           6     806.      416.     234.     122.      1.75
 2 COMBINED         6    6397.     4894.    2810.    1444.     20.86  E.L. Llagas d/s Church Confl.
 2 COMBINED         6   12280.     9825.    6268.    3948.     56.92  Llagas d/s E.L. Llagas Confl.
ROUTED TO          14   11758.     9769.    6261.    3941.     56.92
HYDROGRAPH AT      14     638.      323.     180.      93.      1.31  Skillet u/s Rucker Confl.
ROUTED TO          14     638.      323.     180.      93.      1.31
HYDROGRAPH AT      14     498.      241.     134.      70.      0.93
ROUTED TO          14     498.      241.     134.      70.      0.93
 2 COMBINED        14    1136.      564.     314.     164.      2.24  Rucker u/s Llagas Confl.
HYDROGRAPH AT      14     711.      354.     199.     104.      1.37
ROUTED TO          14     711.      354.     199.     104.      1.37
 2 COMBINED        14    1847.      913.     513.     268.      3.61
 2 COMBINED        14   12456.    10580.    6727.    4209.     60.53  Llagas d/s Rucker Confl.
ROUTED TO          15   12450.    10561.    6724.    4206.     60.53
HYDROGRAPH AT      15     621.      318.     180.      93.      1.43  Panther u/s Llagas Confl.
ROUTED TO          15     621.      318.     180.      93.      1.43
 2 COMBINED        15   12706.    10847.    6889.    4299.     61.96  Llagas d/s Panther Confl.
ROUTED TO          16   12645.    10835.    6888.    4297.     61.96
HYDROGRAPH AT      16     470.      310.     177.      91.      1.33  Live Oak u/s Llagas Confl.
ROUTED TO          16     470.      310.     177.      91.      1.33
HYDROGRAPH AT      16     328.      147.      82.      44.      0.54
ROUTED TO          16     328.      147.      82.      44.      0.54
 2 COMBINED        16     797.      456.     259.     135.      1.87
 2 COMBINED        16   12951.    11214.    7119.    4432.     63.83  Llagas d/s Live Oak Confl.
ROUTED TO          17   12934.    11201.    7117.    4430.     63.83
HYDROGRAPH AT      17    1191.      674.     380.     192.      3.24  Alamias u/s Llagas Confl.
ROUTED TO          17    1191.      674.     380.     192.      3.24
 2 COMBINED        17   13528.    11818.    7469.    4622.     67.07  Llagas d/s Alamias Confl.
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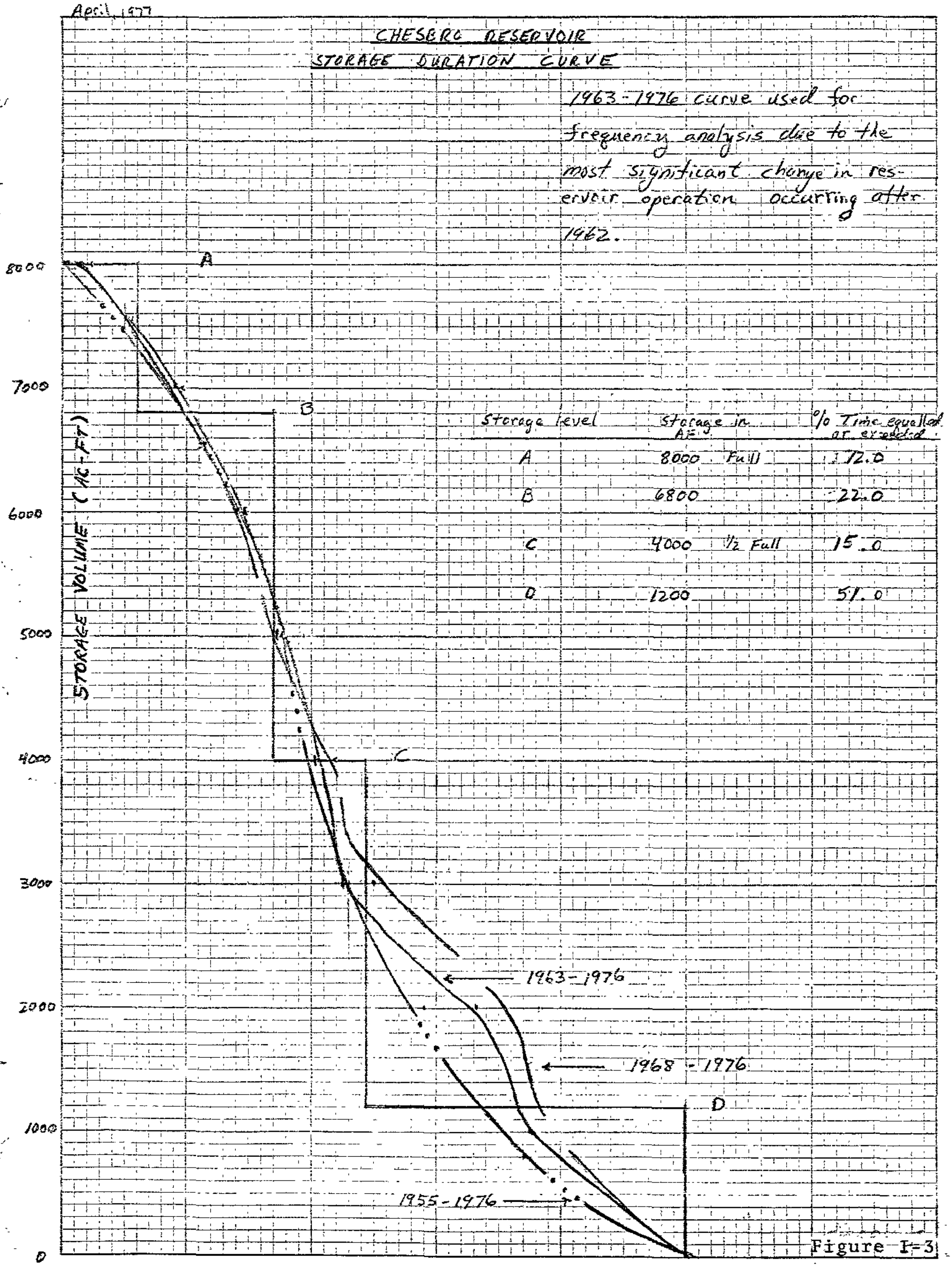
TABLE 1-2(Continued)

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	17	13528.	11818.	7469.	4622.	67.07	
ROUTED TO	18	13374.	11755.	7461.	4615.	67.07	
HYDROGRAPH AT	20	2497.	1520.	876.	437.	5.91	W. Branch Llagas u/s Lions
ROUTED TO	20	2497.	1520.	876.	437.	5.91	
HYDROGRAPH AT	19	495.	248.	141.	74.	0.93	Day u/s Lions Confl.
ROUTED TO	19	495.	248.	141.	74.	0.93	
ROUTED TO	20	407.	247.	141.	74.	0.93	
HYDROGRAPH AT	20	1349.	794.	451.	227.	3.16	Lions u/s W. Branch Llagas
ROUTED TO	20	1349.	794.	451.	227.	3.16	
2 COMBINED	20	1681.	1041.	592.	300.	4.09	
2 COMBINED	20	3481.	2550.	1464.	737.	10.00	W. Branch Llagas d/s Lions Confl.
ROUTED TO	21	3176.	2525.	1460.	737.	10.00	
HYDROGRAPH AT	21	1442.	806.	465.	238.	3.53	
ROUTED TO	21	1442.	806.	465.	238.	3.53	
2 COMBINED	21	4367.	3329.	1925.	975.	13.53	Ronan Diversion u/s W. Branch Llagas Con.
HYDROGRAPH AT	21	336.	137.	85.	41.	0.49	
HYDROGRAPH AT	21	502.	340.	188.	91.	1.46	
2 COMBINED	21	674.	475.	271.	132.	1.95	
ROUTED TO	21	239.	237.	217.	132.	1.95	Miller Slough u/s W. Branch Llagas Confl.
2 COMBINED	21	4595.	3559.	2136.	1107.	15.48	W. Branch Llagas d/s Miller Slough
ROUTED TO	18	4593.	3549.	2135.	1107.	15.48	
HYDROGRAPH AT	18	990.	518.	303.	160.	2.26	
ROUTED TO	18	990.	518.	303.	160.	2.26	
2 COMBINED	18	4950.	4060.	2438.	1267.	17.74	W. Branch Llagas u/s Llagas Confl.
2 COMBINED	18	18074.	15771.	9848.	5882.	84.81	Llagas d/s W. Branch Confl.
ROUTED TO	22	18057.	15759.	9847.	5879.	84.81	
HYDROGRAPH AT	22	353.	205.	127.	61.	0.74	
HYDROGRAPH AT	22	756.	508.	280.	135.	2.22	
2 COMBINED	22	1019.	709.	405.	196.	2.96	
ROUTED TO	22	339.	337.	327.	197.	2.96	Princevale Drain u/s Llagas Confl.
2 COMBINED	22	18415.	16111.	10173.	6075.	87.77	Llagas d/s Princevale Drain
ROUTED TO	23	18143.	16002.	10158.	6067.	87.77	
HYDROGRAPH AT	25	913.	471.	263.	134.	2.96	Jones u/s Ortega Confl.
ROUTED TO	25	913.	471.	263.	134.	2.96	
HYDROGRAPH AT	25	973.	513.	294.	152.	2.58	Ortega u/s Jones Confl.
ROUTED TO	25	973.	513.	294.	152.	2.58	
2 COMBINED	25	1593.	984.	557.	286.	5.54	Jones d/s Ortega Confl.
ROUTED TO	26	1822.	981.	557.	286.	5.54	
HYDROGRAPH AT	26	1881.	912.	512.	257.	4.26	San Ysidro u/s Jones Confl
ROUTED TO	26	1881.	912.	512.	257.	4.26	
HYDROGRAPH AT	26	766.	381.	219.	116.	1.70	Dexter u/s San Ysidro Confl.
ROUTED TO	26	766.	381.	219.	116.	1.70	
2 COMBINED	26	2347.	1290.	731.	372.	5.96	
2 COMBINED	26	3651.	2269.	1286.	659.	11.50	San Ysidro d/s Jones, Dexter Confl.
ROUTED TO	23	3351.	2262.	1285.	658.	11.50	
2 COMBINED	23	20134.	18037.	11371.	6725.	99.27	
ROUTED TO	24	20110.	18023.	11370.	6721.	99.27	
HYDROGRAPH AT	24	1685.	1060.	616.	314.	4.38	Llagas (local) u/s Pajaro River Confl.
ROUTED TO	24	1685.	1060.	616.	314.	4.38	
2 COMBINED	24	21132.	19026.	11963.	7035.	103.65	Llagas Discharge to Pajaro River

April, 1977



CHESBRO RESERVOIR

STORAGE DURATION CURVE

1963-1976 curve used for frequency analysis due to the most significant change in reservoir operation occurring after 1962.

Storage level	Storage in AF	% Time equalled or exceeded
A	8000 Full	72.0
B	6800	22.0
C	4000 ½ Full	15.0
D	1200	51.0

Figure I-3

PREVIOUS STUDIES

In October 1974, the Santa Clara Valley Water District entered a contract to study the Soil Conservation Service Llagas Creek Watershed Work Plan Hydrology. Table 1-3 compiles the results that were obtained by the District in 1974 and 1977 and compares them with the SCS Work Plan results. Values from the U. S. Army Corps of Engineers (Reference 7) are also listed in the same table for comparison.

The method that was used by the District in 1974 is essentially the same as that used in the current study, except that an earlier set of regional regression equations was used in the SCS review. These equations, developed in 1972, were used on Llagas Creek to balance the peak and 24-hour volumes of the hydrographs for all areas. No special urban analysis was undertaken at that time. Routing was done by the Muskingum method through the stream channels and by the modified Puls method through an assumed full reservoir.

CONCLUSION

This report is the summary of work completed in the study of the Llagas Creek Hydrology. The application of the 1976 Regional Equations compares quite favorably with those developed by the Santa Clara Valley Water District's 1974 review of the Soil Conservation Service Llagas Creek Watershed Work Plan Hydrology.

After careful consideration, it is recommended that the flows derived using the 1976 Regional Regression Equations and

TABLE 1-3

COMPARATIVE 1% DESIGN FLOWS - LLAGAS CREEK WATERSHED

		1977 Recommended District 1% Design Flows (cfs) Incidental 6000 AF			1974 District 1% Design Flows (cfs) Chesbro[4]			1967 SCS 1% Design Flows (cfs) Chesbro[4]			1975 Army C of E 1% Design Flows (cfs)
Location	D.A. (Sq.Mi.)	Existing[1]	Enlarged[2]	D.A. (Sq.Mi.)	Existing	Enlarged	D.A. (Sq.Mi.)	Existing	Enlarged	D.A. (Sq.Mi.)	Chesbro[4] Existing[3]
U/S Chesbro Dam	19.2	6550	6550	19.3	7620	7620					
D/S Chesbro Dam	19.2	3940	1920	19.3	4370	2580	19.3	5750	2380	19.3	4700
Llagas D/S W.L. Llagas Confl.	33.8	-	4550	34.1	7480	6230	34.1	6620	4920	27.9	5600
Llagas U/S E.L. Llagas Confl.	36.1	4860	4970	36.4	7230	5970			5400		
Llagas D/S E.L. Llagas Confl.	56.9	12260	11250	57.4	11670	10420	57.4	11000	8900		
San Martin U/S E.L. Llagas Confl.	3.8	1400	1400							4.2	1130
Corralitos U/S Tennant Confl.	1.3	560	560							1.3	370
Tennant U/S Corralitos Confl.	2.0	830	830					640	640	2.3	790
Corralitos @ Middle Ave.	4.3	1680	1680					1440	1440	4.6	1180
Llagas U/S Alamias Confl.	63.8	12800	11980	64.5	12240	10960	64.5	11700	10100		
Llagas D/S West Branch Confl.	84.8	18040	17130	85.8	16630	15520	85.8	17100	16300		
Llagas D/S Prince-vale Drain	87.8	18360	17490	88.8	17190	16020					
Llagas D/S San Ysidro Confl.	103.7	21070	20300	103.7	18670	17550					

1) Existing Chesbro Reservoir, excluding West Little Llagas Creek diversion to Llagas Creek and Ronan diversion near Gilroy.

2) Enlarged Chesbro Reservoir, including West Little Llagas Creek diversion to Llagas Creek and Ronan diversion near Gilroy.

3) Reference 7.

4) Full storage.

a coincident frequency reservoir level be used for design purposes.

The recommended 1% design flows are summarized in Tables 1-4 and 1-5 for the existing and enlarged reservoirs, respectively, along with the 10% design flows in Tables 1-6 and 1-7 for the existing and enlarged reservoirs, respectively. For practical use, the values in these tables whould be rounded up to significant figures. A graphical representation of the frequency regime of Llagas Creek at Pajaro is shown in Figure 1-4.

Table 1-4

1977 1% Flows, Llagas Creek
Chesbro Initial Storage 6000 AF
Existing Reservoir

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	1	6548.	4842.	2984.	1492.	19.20	
ROUTED TO	1	3940.	3655.	1845.	1109.	19.20	Llagas U/S Chesbro Dam
ROUTED TO	2	3868.	3600.	1845.	1107.	19.20	Llagas D/S Chesbro Dam
HYDROGRAPH AT	2	1451.	870.	508.	255.	3.35	
ROUTED TO	2	1451.	870.	508.	255.	3.35	
2 COMBINED	2	4296.	3941.	2203.	1363.	22.55	
HYDROGRAPH AT	2	654.	354.	206.	107.	1.34	Llagas U/S Machado Confl.
ROUTED TO	2	654.	354.	206.	107.	1.34	Machado U/S Llagas Confl.
2 COMBINED	2	4451.	4055.	2358.	1469.	23.89	
ROUTED TO	3	4434.	4044.	2358.	1469.	23.89	Llagas D/S Machado Confl.
HYDROGRAPH AT	3	369.	178.	103.	54.	0.59	
ROUTED TO	3	369.	178.	103.	54.	0.59	
2 COMBINED	3	4511.	4102.	2437.	1523.	24.48	
ROUTED TO	4	4471.	4081.	2437.	1522.	24.48	Llagas U/S Hayes Confl.
HYDROGRAPH AT	4	1359.	802.	465.	233.	3.03	
ROUTED TO	4	1359.	802.	465.	233.	3.03	
2 COMBINED	4	4824.	4375.	2813.	1754.	27.51	
ROUTED TO	6	4632.	4295.	2805.	1752.	27.51	Llagas U/S W. L. Llagas Confl.
HYDROGRAPH AT	6	1126.	620.	349.	178.	2.24	
ROUTED TO	6	1126.	620.	349.	178.	2.24	
2 COMBINED	6	4855.	4486.	3090.	1929.	29.75	
HYDROGRAPH AT	5	500.	301.	188.	91.	1.00	Llagas U/S E. L. Llagas Confl.
ROUTED TO	5	140.	139.	126.	91.	1.00	
HYDROGRAPH AT	5	1421.	999.	561.	271.	4.03	
2 COMBINED	5	1556.	1129.	679.	362.	5.03	
HYDROGRAPH AT	5	566.	290.	167.	87.	1.01	
ROUTED TO	5	566.	290.	167.	87.	1.01	W. L. Llagas U/S Edmundson Confl.
2 COMBINED	5	1892.	1415.	846.	449.	6.04	
ROUTED TO	9	1827.	1405.	844.	450.	6.04	Edmundson U/S W. L. Llagas Confl.
HYDROGRAPH AT	9	1308.	721.	420.	216.	3.07	
ROUTED TO	9	1308.	721.	420.	216.	3.07	
2 COMBINED	9	3135.	2122.	1263.	665.	9.11	
HYDROGRAPH AT	10	2068.	1222.	699.	350.	5.09	
ROUTED TO	10	2068.	1222.	699.	350.	5.09	
ROUTED TO	9	1857.	1221.	699.	350.	5.09	Madrone Channel U/S E. L. Llagas
2 COMBINED	9	4557.	3339.	1962.	1016.	14.20	
HYDROGRAPH AT	7	709.	366.	206.	106.	1.56	E. L. Llagas U/S Corralitos Confl.
ROUTED TO	7	709.	366.	206.	106.	1.56	Tennant U/S Foothill Confl.
HYDROGRAPH AT	7	252.	110.	62.	34.	0.43	
ROUTED TO	7	252.	110.	62.	34.	0.43	Foothill U/S Tennant Confl.
2 COMBINED	7	856.	473.	268.	140.	1.99	
ROUTED TO	8	827.	473.	268.	140.	1.99	Tennant D/S Foothill Confl.
HYDROGRAPH AT	8	338.	157.	87.	45.	0.63	
ROUTED TO	8	338.	157.	87.	45.	0.63	Maple U/S Tennant Confl.
2 COMBINED	8	1045.	626.	354.	186.	2.62	
HYDROGRAPH AT	8	558.	281.	159.	83.	1.27	Tennant D/S Maple Confl.
ROUTED TO	8	558.	281.	159.	83.	1.27	Corralitos U/S Tennant Confl.
2 COMBINED	8	1573.	906.	513.	268.	3.89	
ROUTED TO	9	1438.	905.	513.	268.	3.89	Corralitos D/S Tennant Confl.
HYDROGRAPH AT	9	861.	447.	248.	128.	1.74	
ROUTED TO	9	861.	447.	248.	128.	1.74	
2 COMBINED	9	2182.	1351.	761.	397.	5.63	Corralitos u/s E.L. Llagas Confl.

TABLE 1-4 (Continued)

2 COMBINED	9	6739.	4677.	2718.	1413.	19.83	
ROUTED TO	13	6365.	4664.	2717.	1413.	19.83	E. L. Llagas D/S *Corralitos* Confl.
HYDROGRAPH AT	11	667.	345.	195.	101.	1.59	
ROUTED TO	11	667.	345.	195.	101.	1.59	San Martin U/S Center Confl.
ROUTED TO	12	602.	345.	195.	101.	1.59	
HYDROGRAPH AT	12	518.	252.	142.	75.	1.05	
2 COMBINED	12	1002.	583.	333.	174.	2.64	
ROUTED TO	13	984.	583.	333.	174.	2.64	San Martin U/S New Confl.
HYDROGRAPH AT	13	586.	285.	159.	84.	1.10	
2 COMBINED	13	1396.	834.	477.	249.	3.74	
HYDROGRAPH AT	13	493.	238.	134.	70.	0.92	San Martin U/S E. L. Llagas Confl.
2 COMBINED	13	1725.	1049.	602.	315.	4.66	E. L. Llagas (Local) U/S San Martin
2 COMBINED	13	7438.	5678.	3312.	1728.	24.49	
ROUTED TO	6	7363.	5669.	3310.	1728.	24.49	E. L. Llagas D/S. San Martin Confl.
2 COMBINED	6	11635.	9336.	6190.	3657.	54.24	
HYDROGRAPH AT	6	806.	416.	234.	122.	1.75	
ROUTED TO	6	806.	416.	234.	122.	1.75	Church U/S *E. L. Llagas Confl.*
HYDROGRAPH AT	6	466.	229.	129.	67.	0.93	
ROUTED TO	6	466.	229.	129.	67.	0.93	E. L. Llagas (Local) U/S Llagas
2 COMBINED	6	1272.	644.	363.	189.	2.68	
2 COMBINED	6	12256.	9894.	6529.	3846.	56.92	
ROUTED TO	14	11705.	9847.	6518.	3844.	56.92	Llagas D/S E. L. Llagas Confl.
HYDROGRAPH AT	14	638.	323.	180.	93.	1.31	
ROUTED TO	14	638.	323.	180.	93.	1.31	Skillet U/S Rucker Confl.
HYDROGRAPH AT	14	498.	241.	134.	70.	0.93	
ROUTED TO	14	498.	241.	134.	70.	0.93	
2 COMBINED	14	1136.	564.	314.	164.	2.24	
HYDROGRAPH AT	14	711.	354.	199.	104.	1.37	*Rucker U/S Llagas Confl.*
ROUTED TO	14	711.	354.	199.	104.	1.37	Llagas (Local) U/S Rucker Confl.
2 COMBINED	14	1847.	913.	513.	268.	3.61	
2 COMBINED	14	12404.	10608.	6987.	4113.	60.53	
ROUTED TO	15	12329.	10604.	6986.	4112.	60.53	Llagas D/S Rucker Confl.
HYDROGRAPH AT	15	621.	318.	180.	93.	1.43	
ROUTED TO	15	621.	318.	180.	93.	1.43	Panther U/S Llagas Confl.
2 COMBINED	15	12585.	10871.	7152.	4205.	61.96	
ROUTED TO	16	12514.	10867.	7151.	4205.	61.96	Llagas D/S Panther Confl.
HYDROGRAPH AT	16	470.	310.	177.	91.	1.33	
ROUTED TO	16	470.	310.	177.	91.	1.33	Live Oak U/S Llagas Confl.
HYDROGRAPH AT	16	328.	147.	82.	44.	0.54	
ROUTED TO	16	328.	147.	82.	44.	0.54	Llagas (Local) U/S Live Oak Confl.
2 COMBINED	16	797.	456.	259.	135.	1.87	
2 COMBINED	16	12792.	11218.	7383.	4340.	63.83	
ROUTED TO	17	12807.	11218.	7382.	4339.	63.83	Llagas D/S Live Oak Confl.
HYDROGRAPH AT	17	1191.	674.	380.	192.	3.24	
ROUTED TO	17	1191.	674.	380.	192.	3.24	Alamias U/S Llagas Confl.
2 COMBINED	17	13340.	11800.	7733.	4532.	67.07	Llagas D/S Alamias Confl.

TABLE 1-4 (Continued

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	17	13340.	11801.	7733.	4532.	67.07	
ROUTED TO	18	13210.	11739.	7724.	4530.	67.07	
HYDROGRAPH AT	20	2457.	1529.	876.	437.	5.91	
ROUTED TO	20	2457.	1528.	876.	437.	5.91	W. Branch Llagas U/S Lions
HYDROGRAPH AT	19	495.	248.	141.	74.	0.93	
ROUTED TO	19	495.	248.	141.	74.	0.93	Day U/S Lions Confl.
ROUTED TO	20	407.	247.	141.	74.	0.93	
HYDROGRAPH AT	20	1535.	929.	528.	264.	3.82	
ROUTED TO	20	1535.	929.	528.	264.	3.82	Lions U/S W. Branch Llagas
2 COMBINED	20	1867.	1176.	669.	337.	4.75	
2 COMBINED	20	3621.	2684.	1541.	774.	10.66	
ROUTED TO	21	3340.	2658.	1537.	774.	10.66	W. Branch Llagas D/S Lions Confl.
HYDROGRAPH AT	21	1442.	806.	465.	238.	3.53	
ROUTED TO	21	1442.	806.	465.	238.	3.53	Ronan Diversion U/S W. Branch Lla
2 COMBINED	21	4540.	3462.	2002.	1013.	14.19	
HYDROGRAPH AT	21	236.	137.	85.	41.	0.49	
HYDROGRAPH AT	21	275.	186.	103.	50.	0.80	
2 COMBINED	21	465.	321.	186.	91.	1.29	
ROUTED TO	21	211.	210.	179.	91.	1.29	
2 COMBINED	21	4748.	3669.	2180.	1103.	15.48	Miller Slough (local) U/S W. Branch Llagas
ROUTED TO	18	4545.	3658.	2180.	1103.	15.48	W. Branch Llagas D/S Miller Slouq
HYDROGRAPH AT	18	990.	518.	303.	160.	2.26	
ROUTED TO	18	990.	518.	303.	160.	2.26	
2 COMBINED	18	5102.	4172.	2483.	1263.	17.74	
2 COMBINED	18	18041.	15850.	10144.	5793.	84.81	W. Branch Llagas U/S Llagas Confl.
ROUTED TO	22	17999.	15823.	10145.	5793.	84.81	Llagas D/S W. Branch Confl.
HYDROGRAPH AT	22	353.	205.	127.	61.	0.74	
HYDROGRAPH AT	22	756.	508.	280.	135.	2.22	
2 COMBINED	22	1019.	709.	405.	196.	2.96	
ROUTED TO	22	952.	657.	327.	197.	2.95	
2 COMBINED	22	18357.	16175.	10471.	5989.	87.77	Princevale Drain U/S Llagas Confl.
ROUTED TO	23	18099.	16065.	10454.	5987.	87.77	Llagas D/S Princevale Drain
HYDROGRAPH AT	25	913.	471.	263.	134.	2.96	
ROUTED TO	25	913.	471.	263.	134.	2.96	Jones U/S Ortega Confl.
HYDROGRAPH AT	25	973.	513.	294.	152.	2.58	
ROUTED TO	25	973.	513.	294.	152.	2.58	Ortega U/S Jones Confl.
2 COMBINED	25	1593.	984.	557.	286.	5.54	
ROUTED TO	26	1522.	981.	557.	286.	5.54	Jones D/S Ortega Confl.
HYDROGRAPH AT	26	1581.	912.	512.	257.	4.26	
ROUTED TO	26	1591.	912.	512.	257.	4.26	San Ysidro U/S Jones Confl.
HYDROGRAPH AT	25	766.	341.	219.	116.	1.70	
ROUTED TO	26	766.	341.	219.	116.	1.70	Dexter U/S San Ysidro Confl.
2 COMBINED	26	2347.	1290.	731.	372.	5.96	
2 COMBINED	26	3651.	2269.	1286.	659.	11.50	
ROUTED TO	23	3351.	2262.	1285.	658.	11.50	San Ysidro D/S Jones, Dexter Conf
2 COMBINED	23	20057.	18100.	11668.	6646.	99.27	
ROUTED TO	24	20059.	18072.	11666.	6645.	99.27	
HYDROGRAPH AT	24	1685.	1060.	616.	314.	4.38	
ROUTED TO	24	1685.	1060.	616.	314.	4.38	Llagas U/S Pajaro River Confl. (local)
2 COMBINED	24	21071.	19074.	12260.	6959.	103.65	Llagas Discharge to Pajaro River

TABLE 1-5

1977 1% FLOWS, LLAGAS CREEK
CHESBRO INITIAL STORAGE 6000 AF
ENLARGED RESERVOIR

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	1	6548.	4842.	2984.	1492.	19.20	Llagas u/s Chesbro Dam
ROUTED TO	1	1911.	1845.	1329.	755.	19.20	Llagas d/s Chesbro Dam
ROUTED TO	2	1897.	1832.	1326.	748.	19.20	
HYDROGRAPH AT	2	1451.	870.	508.	255.	3.35	
ROUTED TO	2	1451.	870.	508.	255.	3.35	
2 COMBINED	2	2039.	1970.	1523.	1004.	22.55	Llagas u/s Machado Confl.
HYDROGRAPH AT	2	654.	354.	206.	107.	1.34	Machado u/s Llagas Confl.
ROUTED TO	2	654.	354.	206.	107.	1.34	
2 COMBINED	2	2146.	2033.	1631.	1110.	23.89	Llagas d/s Machado Confl.
ROUTED TO	3	2131.	2030.	1630.	1108.	23.89	
HYDROGRAPH AT	3	369.	178.	103.	54.	0.59	
ROUTED TO	3	369.	178.	103.	54.	0.59	
2 COMBINED	3	2195.	2067.	1691.	1162.	24.48	Llagas u/s Hayes Confl.
HYDROGRAPH AT	3	647.	355.	203.	99.	1.29	Hayes u/s Llagas Confl.
ROUTED TO	3	647.	355.	203.	99.	1.29	
2 COMBINED	3	2648.	2233.	1818.	1261.	25.77	Llagas d/s Hayes Confl.
ROUTED TO	4	2511.	2218.	1817.	1256.	25.77	
HYDROGRAPH AT	4	579.	298.	167.	81.	0.96	
ROUTED TO	4	579.	298.	167.	81.	0.96	
2 COMBINED	4	2907.	2449.	1923.	1337.	26.73	Llagas u/s W. L. Llagas Confl.
HYDROGRAPH AT	5	500.	301.	188.	91.	1.00	
HYDROGRAPH AT	5	1421.	999.	561.	271.	4.03	
2 COMBINED	5	1762.	1293.	746.	362.	5.03	
ROUTED TO	5	634.	630.	574.	362.	5.03	W.L. Llagas u/s Edmundson Confl.
HYDROGRAPH AT	5	566.	290.	167.	87.	1.01	Edmundson u/s W.L. Llagas Confl.
ROUTED TO	5	566.	290.	167.	87.	1.01	
2 COMBINED	5	1139.	873.	723.	449.	6.04	
ROUTED TO	4	1060.	872.	723.	450.	6.04	
2 COMBINED	4	3962.	3307.	2603.	1786.	32.77	
HYDROGRAPH AT	4	580.	297.	170.	88.	1.05	
ROUTED TO	4	580.	297.	170.	88.	1.05	
2 COMBINED	4	4542.	3572.	2733.	1875.	33.82	Llagas d/s W.L. Llagas Confl.
ROUTED TO	6	3667.	3503.	2727.	1863.	33.82	(@ Monterey Highway)
HYDROGRAPH AT	6	1126.	620.	349.	178.	2.24	
ROUTED TO	6	1126.	620.	349.	178.	2.24	
2 COMBINED	6	4975.	4043.	2992.	2041.	36.06	Llagas u/s E.L. Llagas Confl.
HYDROGRAPH AT	10	2068.	1222.	699.	350.	5.09	Madrone Channel u/s E.L. Llagas Confl.
ROUTED TO	10	2068.	1222.	699.	350.	5.09	
ROUTED TO	9	1857.	1221.	699.	350.	5.09	
HYDROGRAPH AT	9	1237.	675.	392.	202.	2.80	E.L. Llagas @ New 101
ROUTED TO	9	1237.	675.	392.	202.	2.80	
2 COMBINED	9	2660.	1897.	1091.	552.	7.89	E.L. Llagas u/s Corralitos Confl.
HYDROGRAPH AT	7	709.	366.	206.	106.	1.56	Tennant u/s Foothill Confl.
ROUTED TO	7	709.	366.	206.	106.	1.56	
HYDROGRAPH AT	7	252.	110.	62.	34.	0.43	Foothill u/s Tennant Confl.
ROUTED TO	7	252.	110.	62.	34.	0.43	
2 COMBINED	7	856.	473.	268.	140.	1.99	Tennant d/s Foothill Confl.
ROUTED TO	8	827.	473.	268.	140.	1.99	
HYDROGRAPH AT	8	338.	157.	87.	45.	0.63	Maple u/s Tennant Confl.
ROUTED TO	8	338.	157.	87.	45.	0.63	
2 COMBINED	8	1045.	626.	354.	186.	2.62	Tennant d/s Maple Confl.
HYDROGRAPH AT	8	558.	281.	159.	83.	1.27	Corralitos u/s Tennant Confl.
ROUTED TO	8	558.	281.	159.	83.	1.27	
2 COMBINED	8	1573.	906.	513.	268.	3.89	Corralitos d/s Tennant Confl.

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ROUTED TO          50     232.     102.      55.      27.     0.38
 2 COMBINED        50    1680.    1009.     568.     295.     4.27  Corralitos @ Middle Ave.
ROUTED TO           9    1634.    1008.     568.     295.     4.27
HYDROGRAPH AT       9     700.     361.     194.      94.     1.36
ROUTED TO           9     700.     361.     194.      94.     1.36
 2 COMBINED         9    2220.    1369.     762.     309.     5.63  Corralitos u/s E.L. Llagas Confl.
 2 COMBINED         9    4880.    3243.    1849.     941.    13.52  E.L. Llagas d/s Corralitos Confl.
ROUTED TO          13    4545.    3235.    1847.     941.    13.52
HYDROGRAPH AT      13     493.     238.     154.      70.     0.92
 2 COMBINED        13    4771.    3445.    1972.    1007.    14.44  E.L. Llagas u/s San Martin Confl.
HYDROGRAPH AT      11     667.     345.     195.     101.     1.59  San Martin u/s Center Confl.
ROUTED TO          11     667.     345.     195.     101.     1.59
ROUTED TO          12     602.     345.     195.     101.     1.59
HYDROGRAPH AT      12     518.     252.     142.      75.     1.05
 2 COMBINED        12    1002.     583.     333.     174.     2.64  San Martin u/s New Confl.
ROUTED TO          13     984.     583.     333.     174.     2.64
HYDROGRAPH AT      13     586.     285.     159.      84.     1.10
 2 COMBINED        13    1396.     834.     477.     249.     3.74  San Martin u/s E.L. Llagas Confl.
 2 COMBINED        13    5709.    4254.    2443.    1256.    18.18  E.L. Llagas d/s San Martin Confl.
ROUTED TO          51    5669.    4251.    2443.    1256.    18.18
HYDROGRAPH AT      51     275.     129.      70.      34.     0.49
ROUTED TO          51     275.     129.      70.      34.     0.49
 2 COMBINED        51    5815.    4376.    2513.    1290.    18.67  E.L. Llagas @ Church Ave.
ROUTED TO           6    5787.    4378.    2513.    1290.    18.67
HYDROGRAPH AT       6     273.     126.      67.      33.     0.44
ROUTED TO           6     273.     126.      67.      33.     0.44
 2 COMBINED         6    5883.    4496.    2579.    1323.    19.11  E.L. Llagas u/s Church Confl.
HYDROGRAPH AT       6     806.     416.     234.     122.     1.75  Church u/s E.L. Llagas Confl.
ROUTED TO           6     806.     416.     234.     122.     1.75
 2 COMBINED         6    6397.    4894.    2810.    1444.    20.86  E.L. Llagas d/s Church Confl.
 2 COMBINED         6   11248.    8814.    5622.    3485.    56.92  Llagas d/s E.L. Llagas Confl.
ROUTED TO          14   10738.    8768.    5613.    3479.    56.92
HYDROGRAPH AT      14     638.     323.     180.      93.     1.31  Skillet u/s Rucker Confl.
ROUTED TO          14     638.     323.     180.      93.     1.31
HYDROGRAPH AT      14     498.     241.     134.      70.     0.93
ROUTED TO          14     498.     241.     134.      70.     0.93
 2 COMBINED        14    1136.     564.     314.     164.     2.24  Rucker u/s Llagas Confl.
HYDROGRAPH AT      14     711.     354.     199.     104.     1.37
ROUTED TO          14     711.     354.     199.     104.     1.37
 2 COMBINED        14    1847.     913.     513.     268.     3.61
 2 COMBINED        14   11470.    9582.    6090.    3747.    60.53  Llagas d/s Rucker Confl.
ROUTED TO          15   11457.    9581.    6089.    3745.    60.53
HYDROGRAPH AT      15     621.     318.     180.      93.     1.43  Panther u/s Llagas Confl.
ROUTED TO          15     621.     318.     180.      93.     1.43
 2 COMBINED        15   11714.    9867.    6258.    3838.    61.96  Llagas d/s Panther Confl.
ROUTED TO          16   11671.    9865.    6257.    3836.    61.96
HYDROGRAPH AT      16     470.     310.     177.      91.     1.33  Live Oak u/s Llagas Confl.
ROUTED TO          16     470.     310.     177.      91.     1.33
HYDROGRAPH AT      16     328.     147.      82.      44.     0.54
ROUTED TO          16     328.     147.      82.      44.     0.54
 2 COMBINED        16     797.     456.     259.     135.     1.87
 2 COMBINED        16   11977.   10248.    6493.    3971.    63.83  Llagas d/s Live Oak Confl.
ROUTED TO          17   11974.   10247.    6493.    3970.    63.83
HYDROGRAPH AT      17    1191.     674.     380.     192.     3.24  Alamias u/s Llagas Confl.
ROUTED TO          17    1191.     674.     380.     192.     3.24
 2 COMBINED        17   12569.   10863.    6851.    4162.    67.07  Llagas d/s Alamias Confl.
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TABLE 1-5(Continued)

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                         RUNOFF SUMMARY, AVERAGE FLOW

                            PEAK     6-HOUR    24-HOUR    72-HOUR      AREA
HYDROGRAPH AT        17    12569.    10863.     6851.      4162.      67.07
ROUTED TO            18    12421.    10806.     6843.      4156.      67.07
HYDROGRAPH AT        20     2457.     1528.      876.       437.       5.91   W. Branch Llagas u/s Lions
ROUTED TO            20     2457.     1528.      876.       437.       5.91
HYDROGRAPH AT        19      495.      248.      141.        74.       0.93   Day u/s Lions Confl.
ROUTED TO            19      495.      248.      141.        74.       0.93
ROUTED TO            20      407.      247.      141.        74.       0.93
HYDROGRAPH AT        20     1349.      794.      451.       227.       3.16   Lions u/s W. Branch Llagas
ROUTED TO            20     1349.      794.      451.       227.       3.16
 2 COMBINED          20     1681.     1041.      592.       300.       4.09
 2 COMBINED          20     3481.     2550.     1464.       737.      10.00   W. Branch Llagas d/s Lions Confl.
ROUTED TO            21     3176.     2525.     1460.       737.      10.00
HYDROGRAPH AT        21     1442.      806.      465.       238.       3.53
ROUTED TO            21     1442.      806.      465.       238.       3.53
 2 COMBINED          21     4367.     3329.     1925.       975.      13.53   Ronan Diversion u/s W. Branch Llagas Con.
HYDROGRAPH AT        21      236.      137.       85.        41.       0.49
HYDROGRAPH AT        21      502.      340.      188.        91.       1.46
 2 COMBINED          21      674.      475.      271.       132.       1.95
ROUTED TO            21      239.      237.      217.       132.       1.95   Miller Slough u/s W. Branch Llagas Confl.
 2 COMBINED          21     4595.     3559.     2136.      1107.      15.48   W. Branch Llagas d/s Miller Slough
ROUTED TO            18     4393.     3549.     2135.      1107.      15.48
HYDROGRAPH AT        18      990.      518.      303.       160.       2.26
ROUTED TO            18      990.      518.      303.       160.       2.26
 2 COMBINED          18     4950.     4060.     2438.      1267.      17.74   W. Branch Llagas u/s Llagas Confl.
 2 COMBINED          18    17130.    14833.     9253.      5423.      84.81   Llagas d/s W. Branch Confl.
ROUTED TO            22    17130.    14831.     9251.      5420.      84.81
HYDROGRAPH AT        22      353.      205.      127.        61.       0.74
HYDROGRAPH AT        22      756.      508.      280.       135.       2.22
 2 COMBINED          22     1019.      709.      405.       196.       2.96
ROUTED TO            22      359.      357.      327.       197.       2.96   Princevale Drain u/s Llagas Confl.
 2 COMBINED          22    17487.    15183.     9577.      5617.      87.77   Llagas d/s Princevale Drain
ROUTED TO            23    17227.    15083.     9561.      5610.      87.77
HYDROGRAPH AT        25      913.      471.      263.       134.       2.96   Jones u/s Ortega Confl.
ROUTED TO            25      913.      471.      263.       134.       2.96
HYDROGRAPH AT        25      973.      513.      294.       152.       2.58   Ortega u/s Jones Confl.
ROUTED TO            25      973.      513.      294.       152.       2.58
 2 COMBINED          25     1593.      984.      557.       286.       5.54   Jones d/s Ortega Confl.
ROUTED TO            26     1522.      981.      557.       286.       5.54
HYDROGRAPH AT        26     1581.      912.      512.       257.       4.26   San Ysidro u/s Jones Confl
ROUTED TO            26     1581.      912.      512.       257.       4.26
HYDROGRAPH AT        26      766.      381.      219.       116.       1.70   Dexter u/s San Ysidro Confl.
ROUTED TO            26      766.      381.      219.       116.       1.70
 2 COMBINED          26     2347.     1290.      731.       372.       5.96
 2 COMBINED          26     3651.     2269.     1286.       659.      11.50   San Ysidro d/s Jones, Dexter Confl.
ROUTED TO            23     3351.     2262.     1285.       658.      11.50
 2 COMBINED          23    19278.    17141.    10791.      6268.      99.27
ROUTED TO            24    19224.    17130.    10790.      6265.      99.27
HYDROGRAPH AT        24     1685.     1060.      616.       314.       4.38   Llagas (local) u/s Pajaro River Confl.
ROUTED TO            24     1685.     1060.      616.       314.       4.38
 2 COMBINED          24    20298.    18132.    11391.      6579.     103.65   Llagas Discharge to Pajaro River
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TABLE 1-6

1977 10% Flows, Llagas Creek
Chesbro Initial Storage 6400 AF
Existing Reservoir

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	1	3117	2741	1463	721	19.20	Llagas U/S Chesbro Dam
ROUTED TO	1	804	732	551	481	19.20	Llagas D/S Chesbro Dam
ROUTED TO	2	789	722	551	480	19.20	
HYDROGRAPH AT	2	702	504	249	122	3.35	
ROUTED TO	2	702	504	249	122	3.35	
2 COMBINED	2	1133	958	736	603	22.55	Llagas U/S Machado Confl.
HYDROGRAPH AT	2	337	218	106	52	1.34	Machado U/S Llagas Confl.
ROUTED TO	2	337	218	106	52	1.34	
2 COMBINED	2	1463	1149	830	655	23.89	Llagas D/S Machado Confl.
ROUTED TO	3	1433	1147	830	654	23.89	
HYDROGRAPH AT	3	189	109	52	26	.59	
ROUTED TO	3	189	109	52	26	.59	
2 COMBINED	3	1591	1254	877	680	24.48	Llagas U/S Hayes Confl.
ROUTED TO	4	1534	1248	877	679	24.48	
HYDROGRAPH AT	4	650	459	225	110	5.03	
ROUTED TO	4	650	459	225	110	5.03	
2 COMBINED	4	2184	1702	1089	790	27.51	Llagas U/S W. L. Llagas Confl.
ROUTED TO	6	1968	1656	1085	788	27.51	
HYDROGRAPH AT	6	495	331	157	77	2.24	
ROUTED TO	6	495	331	157	77	2.24	
2 COMBINED	6	2420	1968	1233	865	29.75	Llagas U/S E. L. Llagas Confl
HYDROGRAPH AT	5	308	204	121	59	1.00	
ROUTED TO	5	114	114	106	59	1.00	
HYDROGRAPH AT	5	915	591	275	132	4.03	
2 COMBINED	5	1028	700	379	191	5.03	W. L. Llagas U/S Edmundson Confl.
HYDROGRAPH AT	5	279	173	82	40	1.01	
ROUTED TO	5	279	173	82	40	1.01	Edmundson U/S W. L. Llagas Confl.
2 COMBINED	5	1259	871	461	231	6.04	
ROUTED TO	9	1187	862	460	231	6.04	
HYDROGRAPH AT	9	564	362	184	91	3.07	
ROUTED TO	9	564	362	184	91	3.07	
2 COMBINED	9	1743	1223	644	322	9.11	
HYDROGRAPH AT	10	855	598	296	146	5.09	Madrone Channel U/S E. L. Llagas
ROUTED TO	10	855	598	296	146	5.09	
ROUTED TO	9	834	597	296	146	5.09	
2 COMBINED	9	2500	1814	940	468	14.20	E. L. Llagas U/S Confl.
HYDROGRAPH AT	7	308	187	90	44	1.56	Tennant U/S Foothill Confl.
ROUTED TO	7	308	187	90	44	1.56	
HYDROGRAPH AT	7	116	60	28	14	.43	Foothill U/S Tennant Confl.
ROUTED TO	7	116	60	28	14	.43	
2 COMBINED	7	408	245	118	58	1.90	Tennant D/S Foothill Confl.
ROUTED TO	8	407	245	118	58	1.99	
HYDROGRAPH AT	8	152	83	39	19	.63	Maple U/S Tennant Confl.
ROUTED TO	8	152	83	39	19	.63	
2 COMBINED	8	548	325	157	78	2.62	Tennant D/S Maple Confl.
HYDROGRAPH AT	8	248	147	70	34	1.27	Corralitos U/S Tennant Confl.
ROUTED TO	8	248	147	70	34	1.27	
2 COMBINED	8	796	472	227	112	3.89	Corralitos D/S Tennant Confl.
ROUTED TO	9	738	470	227	112	3.89	
HYDROGRAPH AT	9	358	223	105	52	1.74	
ROUTED TO	9	358	223	105	52	1.74	
2 COMBINED	9	1067	693	332	163	5.63	Corralitos u/s E.L. Llagas Confl.

TABLE 1-6(Continued)

2 COMBINED	9	3567	2500	1270	631	19.83	
ROUTED TO	13	3436	2490	1270	631	19.83	E. L. Llagas D/S Corralitos Confl.
HYDROGRAPH AT	11	294	179	86	42	1.59	
ROUTED TO	11	294	179	86	42	1.59	San Martin U/S Center Confl.
ROUTED TO	12	299	179	86	42	1.59	
HYDROGRAPH AT	12	227	132	62	30	1.05	
2 COMBINED	12	529	311	149	73	2.64	
ROUTED TO	13	535	311	149	73	2.64	San Martin U/S New Confl.
HYDROGRAPH AT	13	247	145	68	33	1.10	
2 COMBINED	13	791	452	215	105	3.74	
HYDROGRAPH AT	13	220	125	60	29	.92	San Martin U/S E. L. Llagas Confl.
2 COMBINED	13	992	572	273	134	4.66	E. L. Llagas (Local) U/S San Martin
2 COMBINED	13	4116	3038	1540	765	24.49	
ROUTED TO	6	4043	3031	1540	765	24.49	E. L. Llagas D/S San Martin Confl.
2 COMBINED	6	6466	4983	2761	1629	54.24	
HYDROGRAPH AT	6	339	208	99	49	1.75	
ROUTED TO	6	339	208	99	49	1.75	Church U/S Llagas Confl.
HYDROGRAPH AT	6	211	122	59	29	.93	
ROUTED TO	6	211	122	59	29	.93	E. L. Llagas (Local) U/S Llagas
2 COMBINED	6	550	329	158	78	2.68	
2 COMBINED	6	6809	5296	2916	1707	56.92	
ROUTED TO	14	6569	5245	2912	1706	56.92	Llagas D/S E. L. Llagas Confl.
HYDROGRAPH AT	14	279	166	78	38	1.31	
ROUTED TO	14	279	166	78	38	1.31	Skillet U/S Rucker Confl.
HYDROGRAPH AT	14	216	124	58	28	.95	
ROUTED TO	14	216	124	58	28	.95	
2 COMBINED	14	492	290	136	66	2.24	Rucker u/s Llagas Confl.
HYDROGRAPH AT	14	299	178	85	42	1.37	
ROUTED TO	14	299	178	85	42	1.37	Llagas (Local) U/S Rucker Confl.
2 COMBINED	14	791	465	221	108	3.61	
2 COMBINED	14	6925	5663	3126	1815	60.53	
ROUTED TO	15	6913	5651	3125	1814	60.53	Llagas D/S Rucker Confl.
HYDROGRAPH AT	15	277	166	80	39	1.43	
ROUTED TO	15	277	166	80	39	1.43	Panther U/S Llagas Confl.
2 COMBINED	15	7047	5795	3203	1854	61.96	
ROUTED TO	16	7022	5799	3202	1853	61.96	Llagas D/S Panther Confl.
HYDROGRAPH AT	16	206	158	78	38	1.33	
ROUTED TO	16	206	158	78	38	1.33	Live Oak U/S Llagas Confl.
HYDROGRAPH AT	16	145	77	36	18	.54	
ROUTED TO	16	145	77	36	18	.54	Llagas (Local) U/S Live Oak Confl.
2 COMBINED	16	551	234	114	56	1.87	
2 COMBINED	16	7175	5962	3511	1909	63.85	
ROUTED TO	17	7145	5984	3511	1909	63.85	Llagas D/S Live Oak Confl.
HYDROGRAPH AT	17	502	330	161	79	3.24	
ROUTED TO	17	502	330	161	79	3.24	Alamias U/S Llagas Confl.
2 COMBINED	17	7446	6278	3468	1988	67.07	Llagas D/S Alamias Confl.

TABLE 1-6(Continued)

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	17	7446.	6278.	3468.	1988.	67.07	
ROUTED TO	17	7331.	6233.	3464.	1987.	67.07	
HYDROGRAPH AT	20	1060.	781.	386.	189.	5.91	
ROUTED TO	20	1060.	781.	386.	189.	5.91	W. Branch Llagas U/S Lions
HYDROGRAPH AT	19	238.	142.	68.	33.	0.93	
ROUTED TO	19	238.	142.	68.	33.	0.93	Day U/S Lions Confl.
ROUTED TO	20	224.	141.	68.	33.	0.93	
HYDROGRAPH AT	20	703.	504.	245.	120.	3.82	
ROUTED TO	20	703.	504.	245.	120.	3.82	Lions U/S W. Branch Llagas
2 COMBINED	20	927.	645.	313.	153.	4.75	
2 COMBINED	20	1864.	1411.	693.	342.	10.66	
ROUTED TO	21	1785.	1394.	697.	342.	10.66	W. Branch Llagas D/S Lions Confl.
HYDROGRAPH AT	21	607.	391.	199.	99.	3.53	
ROUTED TO	21	607.	391.	199.	99.	3.53	Ronan Diversion U/S W. Branch Llaga
2 COMBINED	21	2272.	1783.	396.	441.	14.19	
HYDROGRAPH AT	21	158.	92.	55.	27.	0.49	
HYDROGRAPH AT	21	170.	109.	51.	24.	0.80	
2 COMBINED	21	278.	199.	105.	51.	1.29	
ROUTED TO	21	198.	193.	104.	51.	1.29	
2 COMBINED	21	2470.	1970.	999.	492.	15.49	Miller Slough (local) u/s W. Branch Llagas
ROUTED TO	18	2453.	1963.	998.	492.	15.48	W. Branch Llagas D/S Miller Slough
HYDROGRAPH AT	18	428.	255.	132.	66.	2.26	
ROUTED TO	18	428.	255.	132.	66.	2.26	
2 COMBINED	18	2741.	2217.	1130.	558.	17.74	
2 COMBINED	18	9952.	8423.	4588.	2545.	84.81	W. Branch Llagas u/s Llagas Confl.
ROUTED TO	22	9941.	8416.	4588.	2545.	84.81	Llagas D/S W. Branch Confl.
HYDROGRAPH AT	22	235.	137.	82.	40.	0.74	
HYDROGRAPH AT	22	470.	297.	138.	66.	2.22	
2 COMBINED	22	649.	431.	219.	106.	2.96	
ROUTED TO	22	314.	310.	217.	106.	2.96	
2 COMBINED	22	10255.	8726.	4798.	2651.	87.77	Princevale Drain u/s Llagas Confl.
ROUTED TO	23	10057.	8652.	4792.	2650.	87.77	Llagas D/S Princevale Drain
HYDROGRAPH AT	25	368.	223.	108.	53.	2.76	
ROUTED TO	5	368.	223.	108.	53.	2.76	Jones U/S Ortega Confl.
HYDROGRAPH AT	25	398.	242.	121.	60.	2.58	
ROUTED TO	25	398.	242.	121.	60.	2.58	Ortega U/S Jones Confl.
2 COMBINED	25	717.	465.	229.	113.	5.54	
ROUTED TO	26	690.	463.	229.	113.	5.54	Jones D/S Ortega Confl.
HYDROGRAPH AT	26	642.	434.	211.	193.	4.26	
ROUTED TO	26	642.	434.	211.	193.	4.26	San Ysidro U/S Jones Confl.
HYDROGRAPH AT	26	318.	184.	92.	46.	1.79	
ROUTED TO	26	319.	184.	92.	46.	1.79	Dexter U/S San Ysidro Confl.
2 COMBINED	26	960.	617.	303.	149.	5.96	
2 COMBINED	26	1579.	1079.	532.	261.	11.50	
ROUTED TO	23	1540.	1074.	531.	261.	11.50	San Ysidro D/S Jones, Dexter Confl.
2 COMBINED	23	10991.	9600.	5313.	2912.	99.27	
ROUTED TO	24	10978.	9596.	5311.	2911.	99.27	
HYDROGRAPH AT	24	672.	469.	240.	119.	4.38	
ROUTED TO	24	672.	469.	240.	119.	4.38	Llagas U/S Pajaro River Confl. (local)
2 COMBINED	24	11444.	10034.	5547.	3030.	103.65	Llagas Discharge to Pajaro River.

TABLE 1-7

1977 10% FLOWS, LLAGAS CREEK
CHESBRO INITIAL STORAGE 6100 AF
ENLARGED RESERVOIR

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	1	3117.	2741.	1463.	721.	19.20	Llagas u/s Chesbro Dam
ROUTED TO	1	285.	277.	215.	146.	19.20	Llagas d/s Chesbro Dam
ROUTED TO	2	283.	275.	214.	146.	19.20	
HYDROGRAPH AT	2	702.	504.	249.	122.	3.35	
ROUTED TO	2	702.	504.	249.	122.	3.35	
2 COMBINED	2	787.	590.	362.	268.	22.55	Llagas u/s Machado Confl.
HYDROGRAPH AT	2	337.	218.	106.	52.	1.34	Machado u/s Llagas Confl.
ROUTED TO	2	337.	218.	106.	52.	1.34	
2 COMBINED	2	1120.	803.	454.	320.	23.89	Llagas d/s Machado Confl.
ROUTED TO	3	1089.	802.	454.	320.	23.89	
HYDROGRAPH AT	3	189.	109.	52.	26.	0.59	
ROUTED TO	3	189.	109.	52.	26.	0.59	
2 COMBINED	3	1250.	908.	504.	346.	24.48	Llagas u/s Hayes Confl.
HYDROGRAPH AT	3	333.	218.	105.	51.	1.29	Hayes u/s Llagas Confl.
ROUTED TO	3	333.	218.	105.	51.	1.29	
2 COMBINED	3	1583.	1125.	607.	396.	25.77	Llagas d/s Hayes Confl.
ROUTED TO	4	1507.	1117.	607.	396.	25.77	
HYDROGRAPH AT	4	278.	172.	81.	39.	0.96	
ROUTED TO	4	278.	172.	81.	39.	0.96	
2 COMBINED	4	1778.	1286.	685.	435.	26.73	Llagas u/s W.L. Llagas Confl.
HYDROGRAPH AT	5	348.	204.	121.	59.	1.00	
HYDROGRAPH AT	5	915.	591.	275.	132.	4.03	
2 COMBINED	5	1157.	790.	394.	191.	5.03	
ROUTED TO	5	540.	533.	390.	191.	5.03	W.L. Llagas u/s Edmundson Confl.
HYDROGRAPH AT	5	279.	174.	82.	39.	1.01	Edmundson u/s W.L. Llagas Confl.
ROUTED TO	5	279.	174.	82.	39.	1.01	
2 COMBINED	5	800.	691.	471.	231.	6.04	
ROUTED TO	4	790.	689.	471.	231.	6.04	
2 COMBINED	4	2559.	1974.	1155.	665.	32.77	
HYDROGRAPH AT	4	280.	169.	82.	40.	1.05	
ROUTED TO	4	280.	169.	82.	40.	1.05	
2 COMBINED	4	2802.	2142.	1236.	706.	33.82	Llagas d/s W.L. Llagas Confl. (@ Monterey Highway)
ROUTED TO	6	2471.	2075.	1227.	704.	33.82	
HYDROGRAPH AT	6	495.	331.	157.	77.	2.24	
ROUTED TO	6	495.	331.	157.	77.	2.24	
2 COMBINED	6	2965.	2390.	1381.	781.	36.06	Llagas u/s E.L. Llagas Confl.
HYDROGRAPH AT	10	855.	598.	296.	146.	5.09	Madrone Channel u/s E.L. Llagas Confl.
ROUTED TO	10	855.	598.	296.	146.	5.09	
ROUTED TO	9	834.	597.	296.	146.	5.09	
HYDROGRAPH AT	9	534.	340.	171.	84.	2.80	E.L. Llagas @ New 101
ROUTED TO	9	534.	340.	171.	84.	2.80	
2 COMBINED	9	1291.	937.	467.	230.	7.89	E.L. Llagas u/s Corralitos Confl.
HYDROGRAPH AT	7	308.	187.	90.	44.	1.56	Tennant u/s Foothill Confl.
ROUTED TO	7	308.	187.	90.	44.	1.56	
HYDROGRAPH AT	7	116.	60.	28.	14.	0.43	Foothill u/s Tennant Confl.
ROUTED TO	7	116.	60.	28.	14.	0.43	
2 COMBINED	7	408.	245.	118.	58.	1.99	Tennant d/s Foothill Confl.
ROUTED TO	8	407.	245.	118.	58.	1.99	
HYDROGRAPH AT	8	152.	83.	39.	19.	0.63	Maple u/s Tennant Confl.
ROUTED TO	8	152.	83.	39.	19.	0.63	
2 COMBINED	8	548.	325.	157.	78.	2.62	Tennant d/s Maple Confl.
HYDROGRAPH AT	8	248.	147.	70.	34.	1.27	Corralitos u/s Tennant Confl.
ROUTED TO	8	248.	147.	70.	34.	1.27	
2 COMBINED	8	785.	472.	227.	112.	3.89	Corralitos d/s Tennant Confl.

```
ROUTED TO        50    104.     53.     25.     12.     0.38
 2 COMBINED      50    876.    525.    251.    124.     4.27   Corralitos @ Middle Ave.
ROUTED TO         9    830.    524.    251.    124.     4.27
HYDROGRAPH AT     9    285.    173.     81.     39.     1.36
ROUTED TO         9    285.    173.     81.     39.     1.36
 2 COMBINED       9   1098.    697.    332.    162.     5.63   Corralitos u/s E.L. Llagas Confl.
 2 COMBINED       9   2389.   1618.    798.    392.    13.52   E.L. Llagas d/s Corralitos Confl.
ROUTED TO        13   2266.   1612.    797.    392.    13.52
HYDROGRAPH AT    13    220.    125.     60.     29.     0.92
 2 COMBINED      13   2398.   1728.    855.    421.    14.44   E.L. Llagas u/s San Martin Confl.
HYDROGRAPH AT    11    294.    179.     86.     42.     1.59   San Martin u/s Center Confl.
ROUTED TO        11    294.    179.     86.     42.     1.59
ROUTED TO        12    299.    179.     86.     42.     1.59
HYDROGRAPH AT    12    227.    132.     62.     30.     1.05
 2 COMBINED      12    529.    311.    149.     73.     2.64   San Martin u/s New Confl.
ROUTED TO        13    535.    311.    149.     73.     2.64
HYDROGRAPH AT    13    247.    145.     68.     33.     1.10
 2 COMBINED      13    791.    452.    215.    105.     3.74   San Martin u/s E.L. Llagas Confl.
 2 COMBINED      13   3024.   2163.   1069.    526.    18.18   E.L. Llagas d/s San Martin Confl.
ROUTED TO        51   3014.   2159.   1069.    526.    18.18
HYDROGRAPH AT    51    130.     69.     33.     16.     0.49
ROUTED TO        51    130.     69.     33.     16.     0.49
 2 COMBINED      51   3100.   2226.   1101.    542.    18.67   E.L. Llagas @ Church Ave.
ROUTED TO         6   3071.   2227.   1101.    542.    18.67
HYDROGRAPH AT     6    126.     67.     31.     15.     0.44
ROUTED TO         6    126.     67.     31.     15.     0.44
 2 COMBINED       6   3158.   2288.   1132.    557.    19.11   E.L. Llagas u/s Church Confl.
HYDROGRAPH AT     6    339.    208.     99.     49.     1.75   Church u/s E.L. Llagas Confl.
ROUTED TO         6    339.    208.     99.     49.     1.75
 2 COMBINED       6   3460.   2485.   1230.    605.    20.86   E.L. Llagas d/s Church Confl.
 2 COMBINED       6   6273.   4854.   2604.   1386.    56.92   Llagas d/s E.L. Llagas Confl.
ROUTED TO        14   6036.   4809.   2600.   1385.    56.92
HYDROGRAPH AT    14    279.    166.     78.     38.     1.31   Skillet u/s Rucker Confl.
ROUTED TO        14    279.    166.     78.     38.     1.31
HYDROGRAPH AT    14    216.    124.     58.     28.     0.93
ROUTED TO        14    216.    124.     58.     28.     0.93
 2 COMBINED      14    492.    290.    136.     66.     2.24   Rucker u/s Llagas Confl.
HYDROGRAPH AT    14    299.    178.     85.     42.     1.37
ROUTED TO        14    299.    178.     85.     42.     1.37
 2 COMBINED      14    791.    465.    221.    108.     3.61
 2 COMBINED      14   6472.   5227.   2814.   1494.    60.53   Llagas d/s Rucker Confl.
ROUTED TO        15   6433.   5214.   2813.   1494.    60.53
HYDROGRAPH AT    15    277.    166.     80.     39.     1.43   Panther u/s Llagas Confl.
ROUTED TO        15    277.    166.     80.     39.     1.43
 2 COMBINED      15   6568.   5362.   2891.   1533.    61.96   Llagas d/s Panther Confl.
ROUTED TO        16   6575.   5363.   2890.   1532.    61.96
HYDROGRAPH AT    16    206.    158.     78.     38.     1.33   Live Oak u/s Llagas Confl.
ROUTED TO        16    206.    158.     78.     38.     1.33
HYDROGRAPH AT    16    145.     77.     36.     18.     0.54
ROUTED TO        16    145.     77.     36.     18.     0.54
 2 COMBINED      16    351.    234.    114.     56.     1.87
 2 COMBINED      16   6728.   5546.   2999.   1588.    63.83   Llagas d/s Live Oak Confl.
ROUTED TO        17   6720.   5550.   2999.   1588.    63.83
HYDROGRAPH AT    17    502.    330.    161.     79.     3.24   Alamias u/s Llagas Confl.
ROUTED TO        17    502.    330.    161.     79.     3.24
 2 COMBINED      17   7020.   5844.   3156.   1667.    67.07   Llagas d/s Alamias Confl.
```

TABLE 1-7(Continued)

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	17	7020.	5844.	3156.	1667.	67.07	
ROUTED TO	18	6896.	5803.	3152.	1666.	67.07	
HYDROGRAPH AT	20	1060.	781.	386.	189.	5.91	W. Branch Llagas u/s Lions
ROUTED TO	20	1060.	781.	386.	189.	5.91	
HYDROGRAPH AT	19	238.	142.	68.	33.	0.93	Day u/s Lions Confl.
ROUTED TO	19	238.	142.	68.	33.	0.93	
ROUTED TO	20	224.	141.	68.	33.	0.93	
HYDROGRAPH AT	20	619.	431.	209.	102.	3.16	Lions u/s W. Branch Llagas
ROUTED TO	20	619.	431.	209.	102.	3.16	
2 COMBINED	20	841.	573.	277.	136.	4.09	
2 COMBINED	20	1773.	1339.	662.	325.	10.00	W. Branch Llagas d/s Lions Confl.
ROUTED TO	21	1694.	1323.	661.	325.	10.00	
HYDROGRAPH AT	21	607.	391.	199.	99.	3.53	
ROUTED TO	21	607.	391.	199.	99.	3.53	Ronan Diversion u/s W. Branch Llagas Con.
2 COMBINED	21	2182.	1713.	860.	424.	13.53	
HYDROGRAPH AT	21	158.	92.	55.	27.	0.49	
HYDROGRAPH AT	21	311.	198.	92.	44.	1.46	
2 COMBINED	21	429.	289.	146.	71.	1.95	
ROUTED TO	21	207.	205.	145.	71.	1.95	Miller Slough u/s W. Branch Llagas Confl.
2 COMBINED	21	2368.	1916.	1004.	495.	15.48	W. Branch Llagas d/s Miller Slough
ROUTED TO	18	2371.	1909.	1004.	495.	15.48	
HYDROGRAPH AT	18	428.	255.	132.	66.	2.26	
ROUTED TO	18	428.	255.	132.	66.	2.26	
2 COMBINED	18	2661.	2162.	1136.	561.	17.74	W. Branch Llagas u/s Llagas Confl.
2 COMBINED	18	9464.	7953.	4280.	2227.	84.81	Llagas d/s W. Branch Confl.
ROUTED TO	22	9458.	7945.	4281.	2227.	84.81	
HYDROGRAPH AT	22	235.	137.	82.	40.	0.74	
HYDROGRAPH AT	22	470.	297.	138.	66.	2.22	
2 COMBINED	22	649.	431.	219.	106.	2.96	
ROUTED TO	22	514.	319.	217.	106.	2.96	Princevale Drain u/s Llagas Confl.
2 COMBINED	22	9172.	8254.	4490.	2333.	87.77	Llagas d/s Princevale Drain
ROUTED TO	23	9573.	8187.	4483.	2332.	87.77	
HYDROGRAPH AT	25	368.	223.	108.	53.	2.96	Jones u/s Ortega Confl.
ROUTED TO	25	368.	223.	108.	53.	2.96	
HYDROGRAPH AT	25	398.	242.	121.	60.	2.58	Ortega u/s Jones Confl.
ROUTED TO	25	398.	242.	121.	60.	2.58	
2 COMBINED	25	717.	465.	229.	113.	5.54	Jones d/s Ortega Confl.
ROUTED TO	25	690.	465.	229.	113.	5.54	
HYDROGRAPH AT	26	642.	434.	211.	103.	4.26	San Ysidro u/s Jones Confl.
ROUTED TO	25	642.	434.	211.	103.	4.26	
HYDROGRAPH AT	26	318.	184.	92.	46.	1.70	Dexter u/s San Ysidro Confl.
ROUTED TO	26	318.	184.	92.	46.	1.70	
2 COMBINED	26	960.	617.	303.	149.	5.96	
2 COMBINED	26	1579.	1079.	532.	261.	11.50	San Ysidro d/s Jones, Dexter Confl.
ROUTED TO	23	1540.	1074.	531.	261.	11.50	
2 COMBINED	23	10533.	9144.	5003.	2593.	99.27	
ROUTED TO	24	10520.	9135.	5002.	2593.	99.27	
HYDROGRAPH AT	24	672.	469.	240.	119.	4.38	Llagas (local) u/s Pajaro River Confl.
ROUTED TO	24	672.	469.	240.	119.	4.38	
2 COMBINED	24	10987.	9574.	5238.	2712.	103.65	Llagas Discharge to Pajaro River

LLAGAS CREEK HYDROLOGY

APRIL 1977

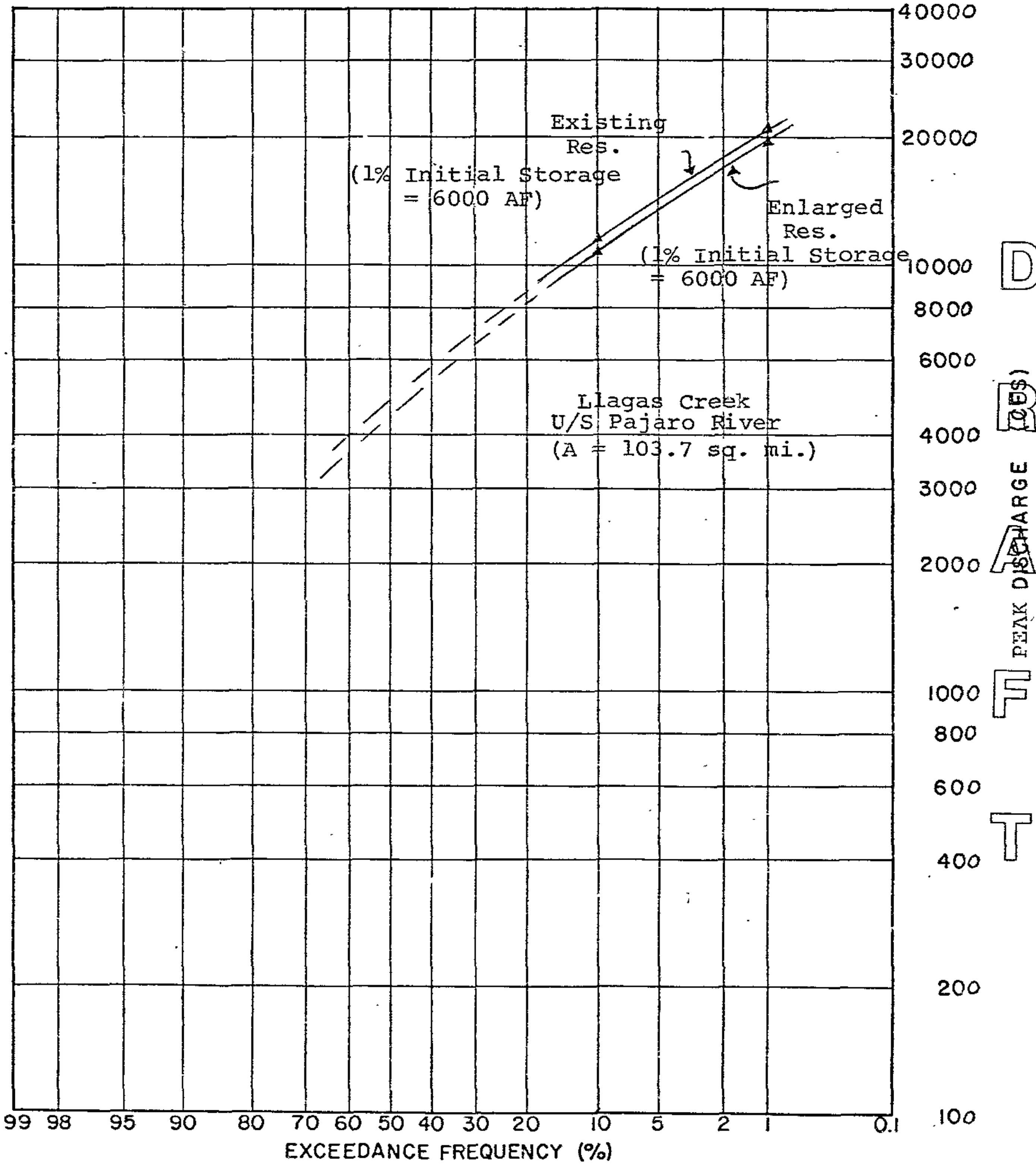

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Figure 1-4

UVAS CREEK HYDROLOGY

DETERMINATION OF DESIGN FLOWS

CONTENTS

Page

GENERAL INFORMATION---------- 2-3
Climate and Hydrologic Characteristics of Basins---------- 2-3

HISTORIC EVENTS---------- 2-4

DISCUSSION OF PROCEDURES---------- 2-5
Basin Characteristics---------- 2-5
Recorded Data and Application of Regional Regression Equations---------- 2-5
Uvas Reservoir---------- 2-13
Initial Reservoir Level - Coincident Frequency---------- 2-13

PREVIOUS STUDIES---------- 2-19

CONCLUSIONS---------- 2-23

FIGURES

Figure

2-1 Uvas Creek Watershed Drainage Area---------- 2-7

2-2 Uvas Creek at Morgan Hill Frequency Curve 1931-1957 (Recorded)---------- 2-8

2-3 Uvas Creek Above Reservoir Frequency Curve 1962-1975 (Recorded)---------- 2-9

2-4 Bodfish Creek Frequency Curve 1960-1975 (Recorded)------ 2-10

2-5 Uvas Reservoir Storage Duration Curve---------- 2-18

2-6 Uvas Creek at Morgan Hill 1931-1957---------- 2-20

2-7 Uvas Creek Above Reservoir 1962-1975---------- 2-21

2-8 Bodfish Creek at Whitehurst Canyon 1960-1975---------- 2-22

2-9 Uvas Creek Hydrology - June 1977---------- 2-29

TABLES

Table		Page
2-1	Application of 1976 Regional Regression Equations - Uvas Stream Gages Data	2-1
2-2	1977 SCVWD 1% Flows for Uvas Reservoir, Full Storage	2-14
2-3	1977 SCVWD 10% Flows for Uvas Reservoir, Full Storage	2-16
2-4	Comparative 1% Design Flows, Uvas Creek Watershed	2-24
2-5	1977 SCVWD 1% Design Flows, Uvas Reservoir, Incidental Storage	2-25
2-6	1977 SCVWD 10% Design Flows, Uvas Reservoir, Incidental Storage	2-27

GENERAL INFORMATION

Uvas Creek is approximately 26 miles long with its headwaters (Figure 2-1) in the Santa Cruz Mountains in southern Santa Clara County. It flows generally southeast to join the Pajaro River about six miles south of Gilroy. The creek drains an area of about 90 square miles. Basin elevations range from a little over 100 feet, mean sea level at the Pajaro River, to heights in excess of 3,000 feet in the upper basin.

The Uvas Creek Basin is primarily mountainous, however, in the northeast portion of the basin, about one-fifth of the area is devoted to agriculture and orchards. There are no large urbanized areas in the basin.

The study area is bounded on the north, west and south by the Santa Cruz Mountains and on the east by the Llagas Creek drainage basin.

Climate and Hydrologic Characteristics of Basins

The Uvas Basin has warm summers, when temperatures may rise above 100 degrees, and mild winters although temperatures may drop below 20 degrees for short periods of time. The main flood season for the Uvas Basin extends from November through April. About 93 percent of the precipitation occurs during these months. Statistically, January is the wettest month, having about 20.7% of the precipitation, July with 0.3 percent of the mean annual precipitation is the driest month. The distribution of vegetative cover follows the mean annual precipitation pattern. It ranges from forest cover on top of the Santa Cruz Mountains, where rainfall is highest, to pasture land at lower elevations.

HISTORIC EVENTS

Damaging floods have occurred on Uvas Creek in 1937, 1940, 1955, 1958 and 1963; however, little data is available except for the flood of 1955. The flood of December 1955, with a flow of 14,000 cfs at Highway 101, is the flood of record. This flood occurred prior to the completion of Uvas Dam in 1957. The dam lies about 17 miles upstream of the junction of the Uvas Creek system with the Pajaro River.

During the general storm period 16-28 December 1955, 12.9 inches of rain reported in the vicinity of Gilroy resulted in significant flooding. Sections of the levees at Gilroy were undercut but none failed. South of Gilroy, Uvas Creek overtopped the left bank and inundated a considerable area of farm land. Farm buildings, crops and land sustained damage.

DISCUSSION OF PROCEDURES

Basin Characteristics

Uvas Creek Watershed was studied as one rural watershed which was composed of subareas A through V (Figure 2-1). A partial list of typical rural subareas shows the following basin characteristics.

Location	Subarea	Drainage Area (Sq.Mi.)	M.A.P. (in.)	Lls ($mi^2/ft/ft^{1/2}$)	T_c (Hrs.)
Croy Creek U/S Uvas Creek	D	2.93	41.0	11.2	.4
Bodfish Creek @ USGS #1541	M	7.32	30.0	46.9	1.1
Whitehurst Creek U/S Bodfish Creek	N	2.83	30.0	11.8	.5
Gavilan Creek @ SPRR Track	R	2.30	22.0	37.5	.9
Tar Creek U/S Carnadero Creek	S	6.39	25.5	386.2	2.6
Tick Creek U/S Carnadero Creek	T	3.55	23.0	44.9	1.0

Recorded Data and Application of Regional Regression Equations

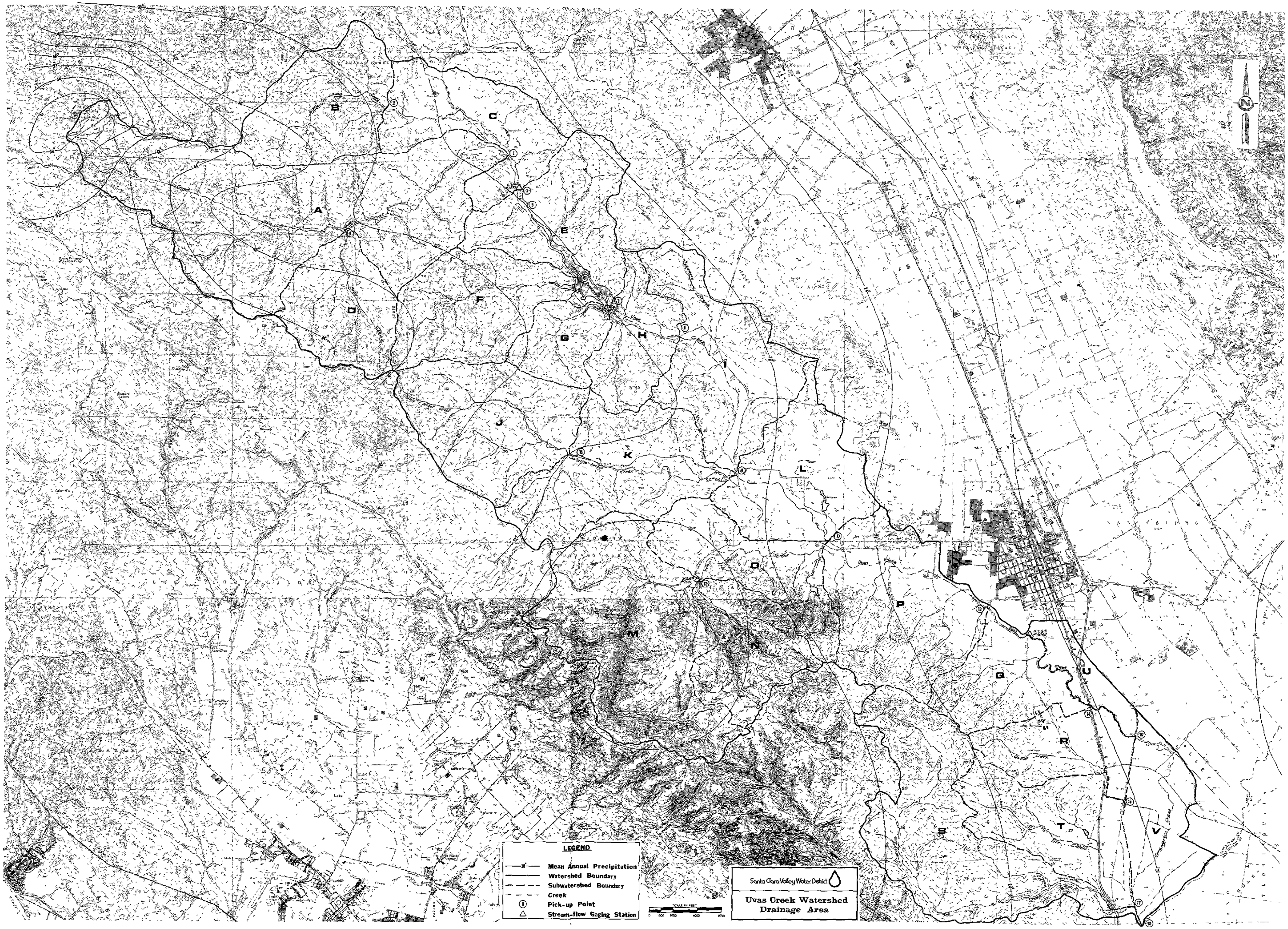
Inherent in the District's hydrology methods are checking procedures that use additional data wherever available. Systematic records, stochastic data and historic data are utilized. Following is a discussion of these procedures and their application to Uvas Creek.

Five streamgage stations on Uvas Creek were used in the analysis. They are as follows:

Gage	Number of Years of Record	Location
USGS # 11-1540	27 (1931-1957)	Uvas Creek at Morgan Hill
USGS # 11-1539	14 (1962-1975)	Uvas Creek above Reservoir
USGS # 11-1541	16 (1960-1975)	Bodfish Creek
SCVWD # 65	11 (1964-1975)	Little Arthur Creek
USGS #11 - 1542	17 (1959-1975	Uvas Creek near Gilroy

Annual peaks and the computed frequency curves for USGS gages 1540, 1539, and 1541 are plotted in Figures 2-2, 2-3, 2-4, respectively.

The location of the three USGS gages and the good reliability of the streamflow records enabled the three gages to be used as base stations in the original regional regression analysis (Reference 5). The gages' flow records were correlated in a matrix with data from 20 other streamflow stations with up to 60 years of record. This correlation enhanced Gage #1540 statistics to be equivalent to 41 years of record and estimated data, Gage #1539 statistics to be equivalent to 56 years, and Gage #1541 statistics to be equivalent to 54 years. Using the regional skewness of -0.6, Table 1 lists comparative one percent and ten percent values at the stream gages locations by using, recorded data, the 1976 regional equations, and the recorded and estimated (stochastic) data. As described in Reference 5, a weighting procedure incorporating information from both Santa Clara Valley Water District values and recorded and estimated values were carried out at the three USGS gage locations. The weighted values are also listed in Table 2-1 for comparison. Because the weighted results from a majority of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LEGEND
28° Mean Annual Precipitation
Watershed Boundary
Subwatershed Boundary
Creek
Pick-up Point
Stream-flow Gaging Station
SCALE IN FEET
0 1000 2000 4000 6000
Santa Clara Valley Water District
Uvas Creek Watershed Drainage Area

Figure 2-1

September, 1976

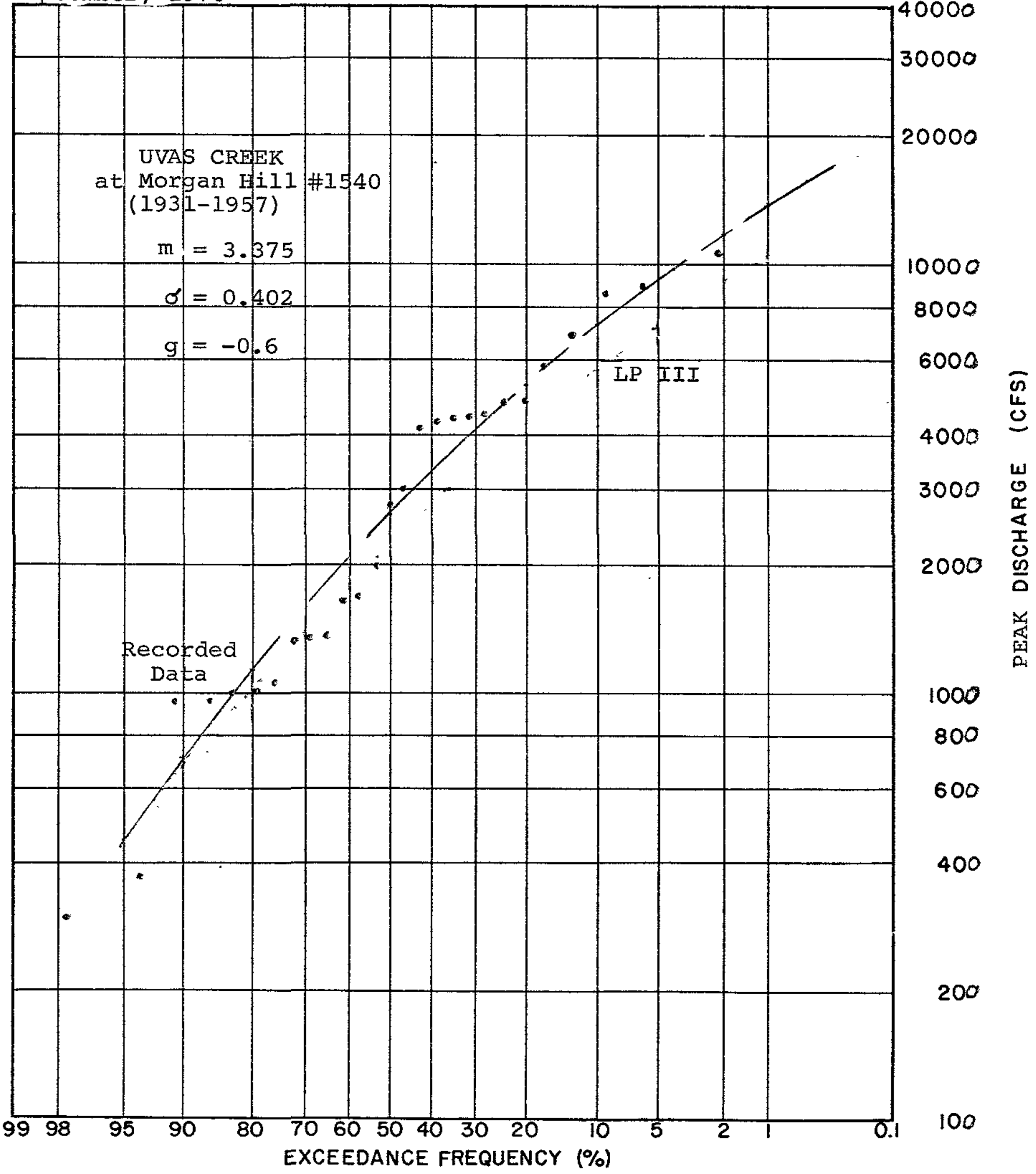


FIGURE 2-2

September, 1976

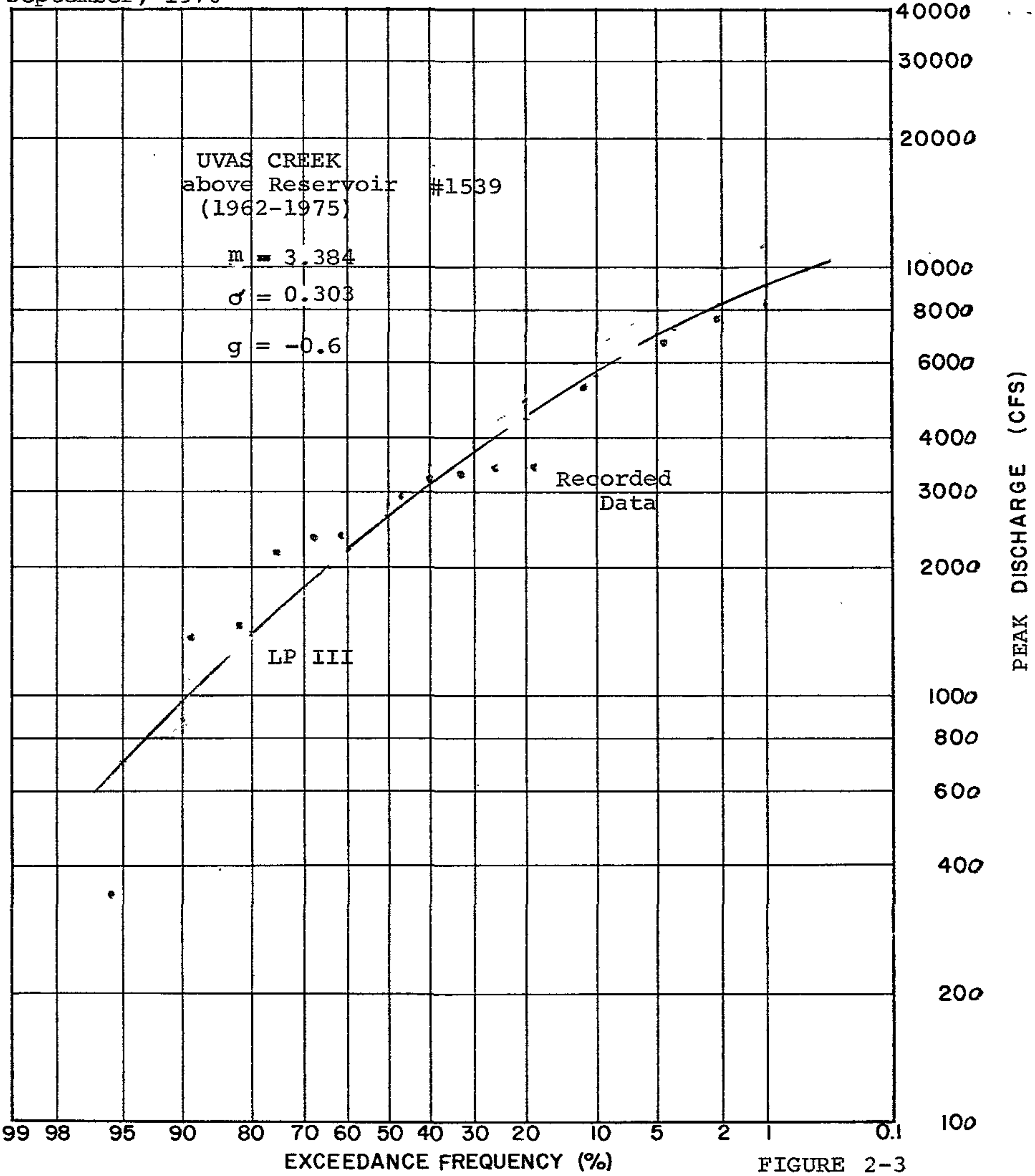


FIGURE 2-3

September, 1976

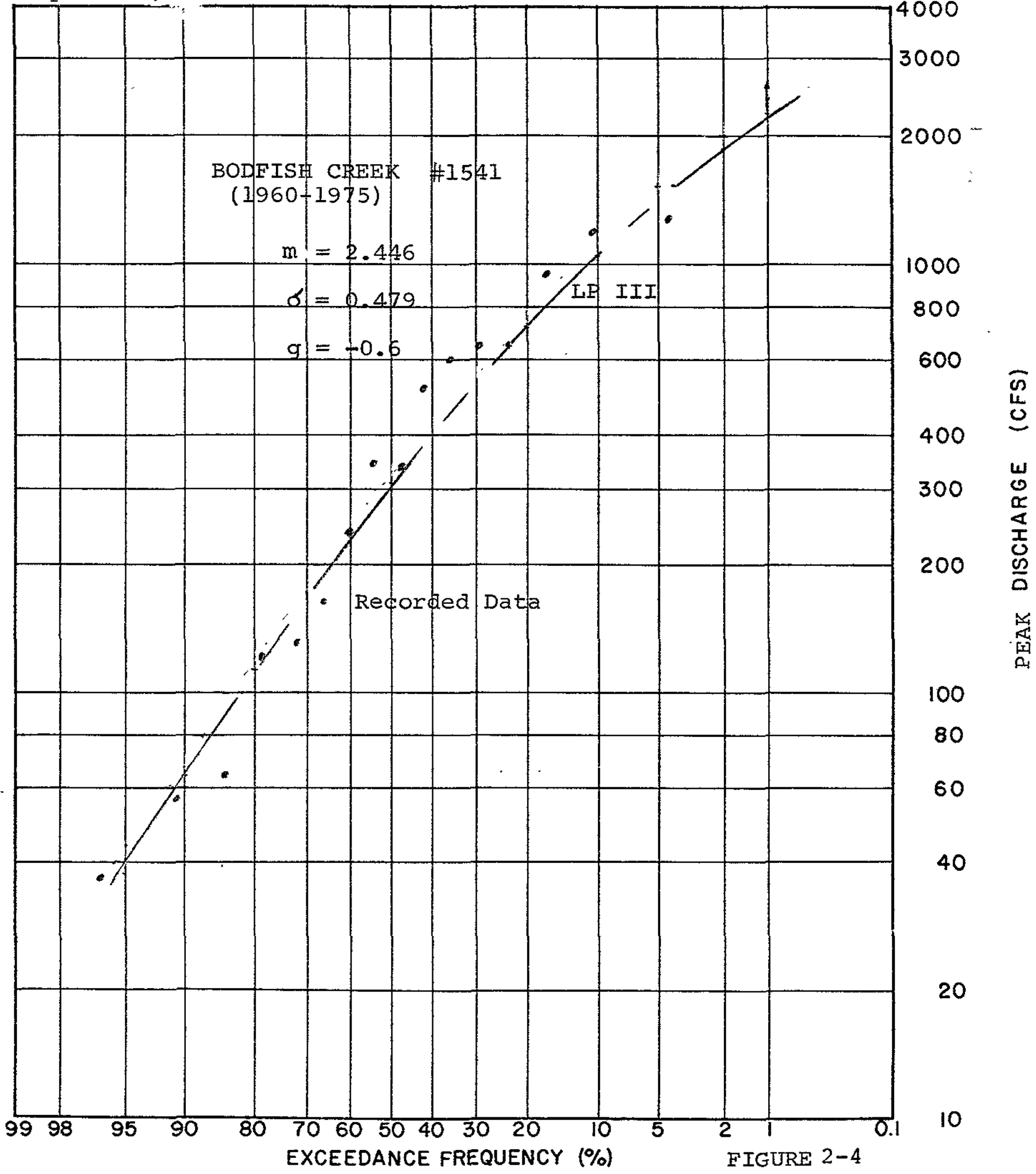


FIGURE 2-4

TABLE 2-1

COMPARISON OF RESULTS*
1976 SCVWD REGIONAL REGRESSION - UVAS STREAMGAGES DATA

	D.A. (Sq.Mi.)	100 Yr. Flood (CFS)	10 Yr. Flood (CFS)
Uvas Creek Near Morgan Hill			
USGS Gage 11-1540 N=27 Yrs.	30.4	13,580	7,210
1977 SCVWD	30.4	11,150	6,610
Weighted Gage and SCVWD		(13,440)	(6,980)
61 Yrs Record and Estimated		11,100	6,440
Weighted 61 Yrs and SCVWD		(12,000)	6,660
24-Hour Gage		5,800	3,320
24-Hour 1977 SCVWD		5,130	2,820
Uvas Creek Above Reservoir			
USGS Gage 11-1539 N=14 Yrs.	21.0	8,960	5,580
1977 SCVWD	21.3	7,830	4,610
Weighted Gage and 1977 SCVWD		(10,270)	(5,710)
61 Yrs Record and Estimated		10,050	5,690
Weighted 61 Yrs and 1977 SCVWD		(10,290)	(5,650)
24-Hour Gage		4,780	2,600
24-Hour 1977 SCVWD		3,690	2,300
Bodfish Creek			
USGS Gage 11-1541 N=16 Yrs.	7.4	2,220	1,050
1977 SCVWD	7.4	2,470	1,270
Weighted Gage & SCVWD		(2,120)	(1,040)
61 Yrs. Record & Estimated		2,320	1,080
Weighted 61 Yrs. & SCVWD		(2,220)	(1,060)
24-Hour Gage		1,090	500
24-Hour 1977 SCVWD		1,020	520
Little Arthur Creek at Sanders Road			
SCVWD #65 N=11 Yrs.		3,350	1,850
1977 SCVWD	9.5	3,350	1,930
Uvas Creek near Gilroy			
USGS Gage 11-1542 N=17 Yrs. (regulated by Uvas Reservoir)	71.2	14,310	6,570
1977 SCVWD	69.1	14,100	6,560

* Published data is available until 1975. Preliminary USGS data from the 1976 water year produced relatively higher values than what is reported. However, the peak 1976 flow of 72 cfs for Station 1539 was found to be close to the low outlier limit of 65 cfs, indicating that year's flow was of questionable reliability for frequency analysis. Inclusion of the preliminary 1976 data in the frequency analysis was, therefore, thought inappropriate at this time.

the watershed's gages are within 10 percent of the regional ones, the results obtained from the regional equations have been chosen for the sake of homogeneity with other noninstrumented locations.

Historic Data

Information from major floods occurring before the period of systematic data collection can sometimes be used to make estimates of peak discharge. Use of historic data in addition to improving the frequency determinations assures that estimates fit community experiences.

At the time of the December 1955 flood, the Gilroy Evening Dispatch included the following excerpt: "Do you remember the big flood of 1937? Until today that overlow was THE FLOOD, at least since the one in 1880." Therefore, the 1955 flood of 10,300 cfs at USGS Gate #11-1540 (Uvas @ Morgan Hill) was equaled or exceeded once in 75 years, making it about a 75-year or 1.3 percent flood. Similarly, the 1937 flood of 8,630 cfs at the gage was therefore equaled or exceeded twice in the 75-year period, making it about a 38-year or 2.7 percent flow. These two flows were used in computing the gage statistics for USGS #11-1540, which are included on Figure 2-6 for reference.

Uvas Reservoir

The upper part of Uvas Creek Watershed is regulated by Uvas Reservoir. The Reservoir impounds a 10,000 acre-feet capacity at its spillway elevation of 487.5 feet. Built in 1957, the Reservoir has a tributary drainage area of approximately thirty square miles.

With 10,000 acre-feet as the initial reservoir storage, the one percent flow rates are tabulated in Table 2-2, and the ten percent flow rates are tabulated in Table 2-3.

Initial Reservoir Level - Coincident Frequency

Uvas Reservoir is operated as a water conservation facility, but it provides incidental flood protection since it could be less than full when a large flood occurs. Even a full reservoir will attenuate a flood peak to some degree.

Because there is a very good chance that the reservoir would not be full at the time design flows occur, it was necessary to determine an initial reservoir level which would account for the compounded probabilities between the incoming flow and initial storage. This would give a realistic value for an outflow which would have a percentage chance equal to that of the inflow. The procedure followed is documented in the Corps of Engineers' Statistical Methods in Hydrology. The results for Uvas, considering storage data between 1963 and 1976, indicate that the initial one percent reservoir storage should be 6,800 acre-feet (68 percent of capacity) and the initial ten percent reservoir storage should be 6,950 acre-feet (70% of capacity). As indicated in Figure 2-5, there is a gradual trend in keeping the reservoir at storages nearer to capacity.

TABLE -2

1977 SCVWD 1% FLOWS

UVAS RESERVOIR, FULL STORAGE

```
                    RUNOFF SUMMARY, AVERAGE FLOW

                            PEAK    6-HOUR   24-HOUR   72-HOUR     AREA
 HYDROGRAPH AT         1    4353.    3302.    1994.      986.     11.26
 ROUTED TO             1    4353.    3302.    1994.      986.     11.26
 HYDROGRAPH AT         4    1379.     909.     541.      266.      2.93   Croy Creek U/S Uvas Creek
 ROUTED TO             4    1379.     909.     541.      266.      2.93
 ROUTED TO             1    1134.     894.     539.      266.      2.93
  2 COMBINED           1    5487.    4196.    2532.     1252.     14.19   Uvas Creek U/S Little Uvas Creek
 ROUTED TO             3    5392.    4192.    2532.     1252.     14.19
 HYDROGRAPH AT         2    1530.    1010.     604.      298.      3.63
 ROUTED TO             2    1530.    1010.     604.      298.      3.63
 ROUTED TO             3    1249.     995.     602.      298.      3.63
 HYDROGRAPH AT         3    1499.     936.     556.      273.      3.53
 ROUTED TO             3    1499.     936.     556.      273.      3.53
  2 COMBINED           3    2658.    1922.    1156.      571.      7.16
  2 COMBINED           3    7825.    6115.    3688.     1823.     21.35   Uvas Creek @ USGS #1539
 ROUTED TO             7    7863.    6109.    3688.     1823.     21.35
 HYDROGRAPH AT         7    1435.     853.     520.      263.      3.86
 ROUTED TO             7    1435.     853.     520.      263.      3.86
  2 COMBINED           7    8320.    6962.    4208.     2085.     25.21
 HYDROGRAPH AT         7    1650.    1090.     644.      315.      3.69
 ROUTED TO             7    1650.    1090.     644.      315.      3.69
 HYDROGRAPH AT         7     835.     487.     284.      138.      1.56
 ROUTED TO             7     835.     487.     284.      138.      1.56
  2 COMBINED           7    2485.    1575.     928.      453.      5.25
  2 COMBINED           7   11151.    8502.    5126.     2538.     30.46   Uvas Creek @ USGS #1540
 ROUTED TO             7    9284.    8030.    4591.     2552.     30.46
 ROUTED TO             8    9189.    8004.    4589.     2552.     30.46
 HYDROGRAPH AT         8     995.     592.     346.      168.      2.05
 ROUTED TO             9     995.     592.     346.      168.      2.05
  2 COMBINED           8    9621.    8446.    4875.     2720.     32.51   Uvas Creek @ Watsonville Road Bridge
 ROUTED TO             9    9270.    8317.    4866.     2720.     32.51
 HYDROGRAPH AT         9    1953.    1260.     735.      360.      4.74
 ROUTED TO             9    1953.    1250.     735.      360.      4.74
  2 COMBINED           9   10344.    9371.    5504.     3080.     37.25   Uvas Creek U/S Little Arthur Creek
 HYDROGRAPH AT        10    1795.    1202.     723.      356.      4.58
 ROUTED TO            10    1795.    1202.     723.      356.      4.58
 ROUTED TO             9    1496.    1186.     720.      356.      4.58
 HYDROGRAPH AT         9    1954.    1268.     754.      370.      4.88
 ROUTED TO             9    1954.    1268.     754.      370.      4.88
  2 COMBINED           9    3354.    2445.    1473.      726.      9.46   Little Arthur Creek @ SCVWD #65
  2 COMBINED           9   12645.   11567.    6849.     3806.     46.71   Uvas Creek D/S Little Arthur Creek
 ROUTED TO            11   12507.   11463.    6842.     3806.     46.71
 HYDROGRAPH AT        11    1474.     887.     526.      262.      3.63
 ROUTED TO            11    1474.     897.     526.      262.      3.63
  2 COMBINED          11   13305.   12280.    7337.     4068.     50.34   Uvas U/S Bodfish Creek
 HYDROGRAPH AT        12    2469.    1711.    1016.      501.      7.32   Bodfish Creek @ USGS #1541
 ROUTED TO            12    2469.    1711.    1016.      501.      7.32
 HYDROGRAPH AT        12    1151.     716.     417.      204.      2.83   Whitehurst Creek U/S Bodfish Creek
 ROUTED TO            12    1151.     716.     417.      204.      2.83
  2 COMBINED          12    3436.    2426.    1432.      705.     10.15
 ROUTED TO            11    3024.    2393.    1427.      705.     10.15
 HYDROGRAPH AT        11    1420.     888.     515.      251.      3.46
 ROUTED TO            11    1420.     888.     515.      251.      3.46
  2 COMBINED          11    4273.    3271.    1939.      957.     13.61   Bodfish Creek U/S Uvas Creek
  2 COMBINED          11   16672.   15278.    9190.     5025.     63.95   Uvas Creek D/S Bodfish Creek
```

TABLE 2-2(Continued)

HYDROGRAPH AT	13	1828.	1154.	668.	330.	5.11	
ROUTED TO	13	1828.	1154.	668.	330.	5.11	
2 COMBINED	13	17220.	15983.	9788.	5355.	69.06	Uvas Creek D/S Reservoir Canyon Creek
ROUTED TO	14	16847.	15735.	9758.	5355.	69.05	
HYDROGRAPH AT	14	1129.	647.	363.	176.	2.54	
ROUTED TO	14	1129.	647.	363.	176.	2.54	
2 COMBINED	14	17198.	16111.	10076.	5531.	71.60	Uvas Creek A U.S. Highway 101
ROUTED TO	16	17179.	16084.	10073.	5531.	71.60	
HYDROGRAPH AT	16	508.	318.	176.	85.	1.06	
ROUTED TO	16	508.	318.	176.	85.	1.05	
2 COMBINED	16	17347.	16285.	10227.	5616.	72.66	Uvas Creek @ SPRR Track
ROUTED TO	18	16873.	15947.	10177.	5616.	72.66	
HYDROGRAPH AT	18	1256.	697.	387.	188.	2.60	
ROUTED TO	18	1256.	697.	387.	188.	2.60	
2 COMBINED	18	17237.	16339.	10513.	5804.	75.26	
HYDROGRAPH AT	15	994.	566.	318.	155.	2.30	Gavilan Creek @ SPRR Track
ROUTED TO	15	994.	566.	318.	155.	2.30	
ROUTED TO	17	803.	561.	317.	155.	2.30	
HYDROGRAPH AT	17	2672.	1711.	982.	479.	6.39	Tar Creek U/S Carnadero Creek
ROUTED TO	17	2672.	1711.	982.	479.	6.39	
HYDROGRAPH AT	17	1379.	825.	475.	234.	3.55	Tick Creek U/S Carnadero Creek
ROUTED TO	17	1379.	825.	475.	234.	3.55	
2 COMBINED	17	3587.	2537.	1457.	713.	9.94	
2 COMBINED	17	4311.	3098.	1774.	867.	12.24	
ROUTED TO	18	4176.	3095.	1774.	867.	12.24	
2 COMBINED	18	19022.	18454.	12077.	6671.	87.50	Uvas-Carnadero Discharge to Pajaro River

TABLE 2-3

1977 SCVWD 10% FLOWS

UVAS RESERVOIR, FULL STORAGE

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	1	2333.	2009.	1092.	528.	11.25	
ROUTED TO	1	2333.	2009.	1092.	528.	11.25	
HYDROGRAPH AT	4	802.	604.	314.	152.	2.93	Croy Creek U/S Uvas Creek
ROUTED TO	4	802.	604.	314.	152.	2.93	
ROUTED TO	1	734.	591.	313.	152.	2.93	
2 COMBINED	1	3057.	2600.	1395.	680.	14.19	Uvas Creek U/S Little Uvas Creek
ROUTED TO	3	3055.	2599.	1395.	680.	14.19	
HYDROGRAPH AT	2	859.	647.	339.	165.	3.63	
ROUTED TO	2	859.	649.	339.	165.	3.63	
ROUTED TO	3	785.	635.	338.	165.	3.63	
HYDROGRAPH AT	3	778.	573.	290.	141.	3.53	
ROUTED TO	3	778.	573.	290.	141.	3.53	
2 COMBINED	3	1561.	1203.	627.	306.	7.15	
2 COMBINED	3	4610.	3802.	2022.	986.	21.35	Uvas Creek @ USGS #1539
ROUTED TO	7	4602.	3799.	2022.	986.	21.55	
HYDROGRAPH AT	7	771.	541.	288.	143.	3.85	
ROUTED TO	7	771.	541.	288.	143.	3.85	
2 COMBINED	7	5259.	4339.	2310.	1129.	25.21	
HYDROGRAPH AT	7	906.	693.	356.	172.	3.69	
ROUTED TO	7	906.	693.	356.	172.	3.69	
HYDROGRAPH AT	7	455.	312.	155.	75.	1.55	
ROUTED TO	7	455.	312.	155.	75.	1.56	
2 COMBINED	7	1361.	1005.	511.	247.	5.25	
2 COMBINED	7	6610.	5312.	2817.	1376.	30.46	Uvas Creek @ USGS #1540
ROUTED TO	7	3768.	3625.	2488.	1397.	30.45	
ROUTED TO	8	3760.	3616.	2487.	1397.	30.46	
HYDROGRAPH AT	8	531.	372.	185.	89.	2.05	
ROUTED TO	8	531.	372.	185.	89.	2.05	
2 COMBINED	8	3912.	3771.	2640.	1486.	32.51	Uvas Creek @ Watsonville Road Bridge
ROUTED TO	9	3878.	3746.	2633.	1486.	32.51	
HYDROGRAPH AT	9	973.	730.	369.	179.	4.74	
ROUTED TO	9	973.	730.	369.	179.	4.74	
2 COMBINED	9	4281.	4223.	2948.	1665.	37.25	Uvas Creek U/S Little Arthur Creek
HYDROGRAPH AT	10	989.	771.	399.	194.	4.58	
ROUTED TO	10	989.	771.	399.	194.	4.58	
ROUTED TO	9	932.	755.	398.	194.	4.58	
HYDROGRAPH AT	9	999.	765.	389.	189.	4.88	
ROUTED TO	9	999.	765.	389.	189.	4.88	
2 COMBINED	9	1931.	1514.	786.	383.	9.46	Little Arthur Creek @ SCVWD #65
2 COMBINED	9	6155.	5569.	3643.	2048.	46.71	Uvas Creek D/S Little Arthur Creek
ROUTED TO	11	6000.	5531.	3639.	2048.	46.71	
HYDROGRAPH AT	11	720.	505.	260.	128.	3.63	
ROUTED TO	11	720.	505.	260.	128.	3.63	
2 COMBINED	11	6568.	5994.	3876.	2175.	50.34	Uvas U/S Bodfish Creek
HYDROGRAPH AT	12	1268.	1005.	522.	254.	7.32	Bodfish Creek @ USGS #1541
ROUTED TO	12	1268.	1005.	522.	254.	7.32	
HYDROGRAPH AT	12	612.	440.	222.	108.	2.83	Whitehurst Creek U/S Bodfish Creek
ROUTED TO	12	612.	440.	222.	108.	2.83	
2 COMBINED	12	1878.	1444.	744.	362.	10.15	
ROUTED TO	11	1767.	1417.	742.	362.	10.15	
HYDROGRAPH AT	11	721.	525.	263.	127.	3.45	
ROUTED TO	11	721.	525.	263.	127.	3.46	
2 COMBINED	11	2480.	1934.	1004.	489.	13.61	Bodfish Creek U/S Uvas Creek
2 COMBINED	11	8948.	7820.	4791.	2664.	63.95	Uvas Creek D/S Bodfish Creek

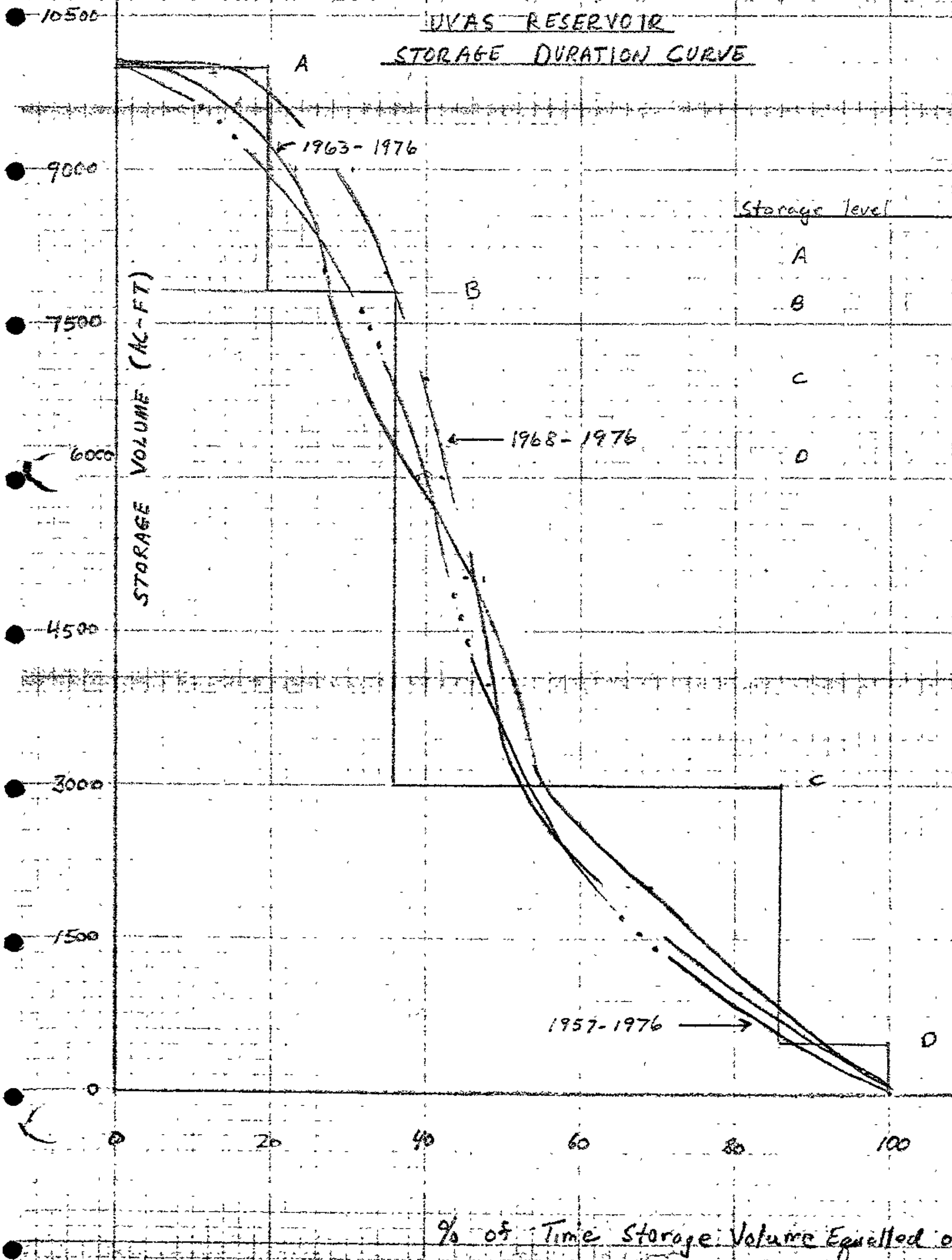
2 COMBINED	12	1878.	1444.	744.	362.	10.15	
ROUTED TO	11	1767.	1417.	742.	362.	10.15	
HYDROGRAPH AT	11	721.	525.	263.	127.	3.45	
ROUTED TO	11	721.	525.	263.	127.	3.46	
2 COMBINED	11	2490.	1934.	1004.	489.	13.61	Bodfish Creek U/S Uvas Creek
2 COMBINED	11	8948.	7820.	4791.	2664.	63.95	Uvas Creek D/S Bodfish Creek
ROUTED TO	13	8552.	7711.	4791.	2664.	63.95	
HYDROGRAPH AT	13	860.	630.	318.	155.	5.11	
ROUTED TO	13	860.	630.	318.	155.	5.11	
2 COMBINED	13	9179.	8252.	5069.	2819.	69.05	Uvas Creek D/S Reservoir Canyon Creek
ROUTED TO	14	8379.	8131.	5058.	2819.	69.05	
HYDROGRAPH AT	14	512.	343.	167.	81.	2.54	
ROUTED TO	14	512.	343.	167.	81.	2.54	
2 COMBINED	14	9037.	8347.	5201.	2900.	71.60	Uvas Creek At U.S. Highway 101
ROUTED TO	16	9043.	8335.	5200.	2900.	71.60	
HYDROGRAPH AT	16	239.	164.	77.	37.	1.06	
ROUTED TO	16	239.	164.	77.	37.	1.06	
2 COMBINED	16	9128.	8445.	5265.	2937.	72.65	Uvas Creek @ SPRR Track
ROUTED TO	18	8813.	8254.	5247.	2936.	72.65	
HYDROGRAPH AT	18	527.	348.	166.	80.	2.60	
ROUTED TO	18	527.	348.	166.	80.	2.60	
2 COMBINED	18	8988.	8461.	5387.	3016.	75.25	
HYDROGRAPH AT	15	460.	310.	149.	72.	2.30	Gavilan Creek @ SPRR Track
ROUTED TO	15	460.	310.	149.	72.	2.30	
ROUTED TO	17	431.	306.	149.	72.	2.30	
HYDROGRAPH AT	17	1199.	921.	450.	217.	6.39	Tar Creek U/S Carnadero Creek
ROUTED TO	17	1199.	921.	450.	217.	6.39	
HYDROGRAPH AT	17	644.	447.	224.	109.	3.55	Tick Creek U/S Carnadero Creek
ROUTED TO	17	644.	447.	224.	109.	3.55	
2 COMBINED	17	1828.	1368.	674.	326.	9.94	
2 COMBINED	17	2239.	1674.	823.	398.	12.24	
ROUTED TO	18	2263.	1673.	823.	398.	12.24	
2 COMBINED	18	10137.	9648.	6096.	3415.	87.50	Uvas-Carnadero Discharge to Pajaro River

By M. Kolyn Date June, 1977 Chkd. By ______ Date ______ Sheet No. ______ of ______

Subject ______ Job No. ______

1963-1976 curve used for frequency analysis due to the most significant change in reservoir operation occurring after 1962.

UVAS RESERVOIR STORAGE DURATION CURVE



Storage level	AC-FT	% Time equalled or exceeded
A	10,000 (FULL)	19.6
B	7800	36.4
C	3000	50.0
D	450	14.0

Figure 2-5

PREVIOUS STUDIES

The past Santa Clara Valley Water District regional equations as developed in 1972 (3rd generation equations) have been used until revised by the 1976 equations. How well each set of equations represents the Uvas Basin at gaged locations is shown in Table 2-4, and illiustrated graphically in Figures 2-6, 2-7, and 2-8 where each flow frequency curve is plotted in comparison with the recorded and estimated data at the three USGS streamgages. The USGS has developed its own set of regression equations for the San Francisco Bay Region, which were used to develop the USGS frequency curves shown in the figures. The graphic comparison of the curves in these Figures proves the high applicability of the 1976 regional equations to the Uvas Basin.

September 1976

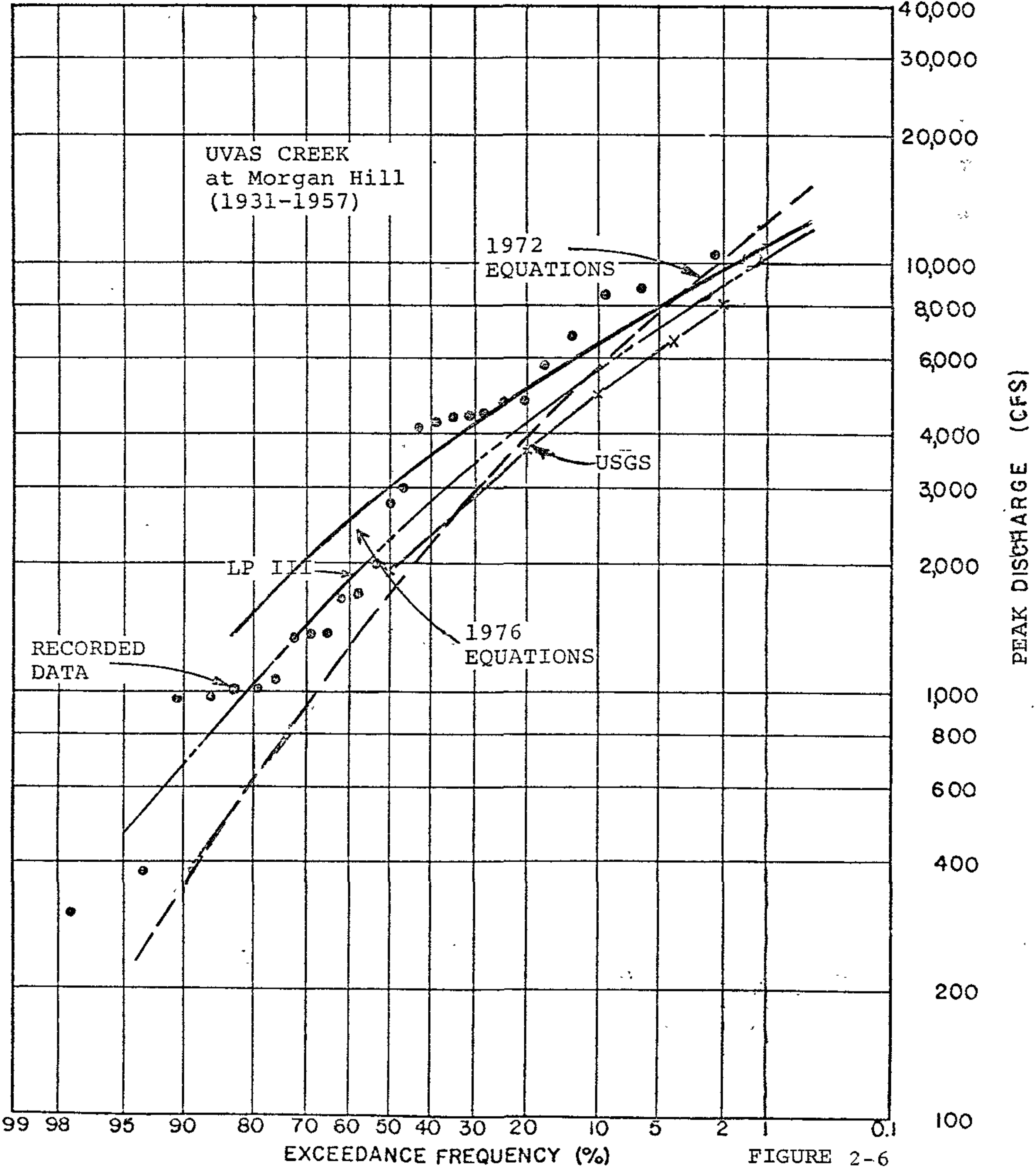


FIGURE 2-6

LP III Curve is from Recorded and estimated Data.

September 1976

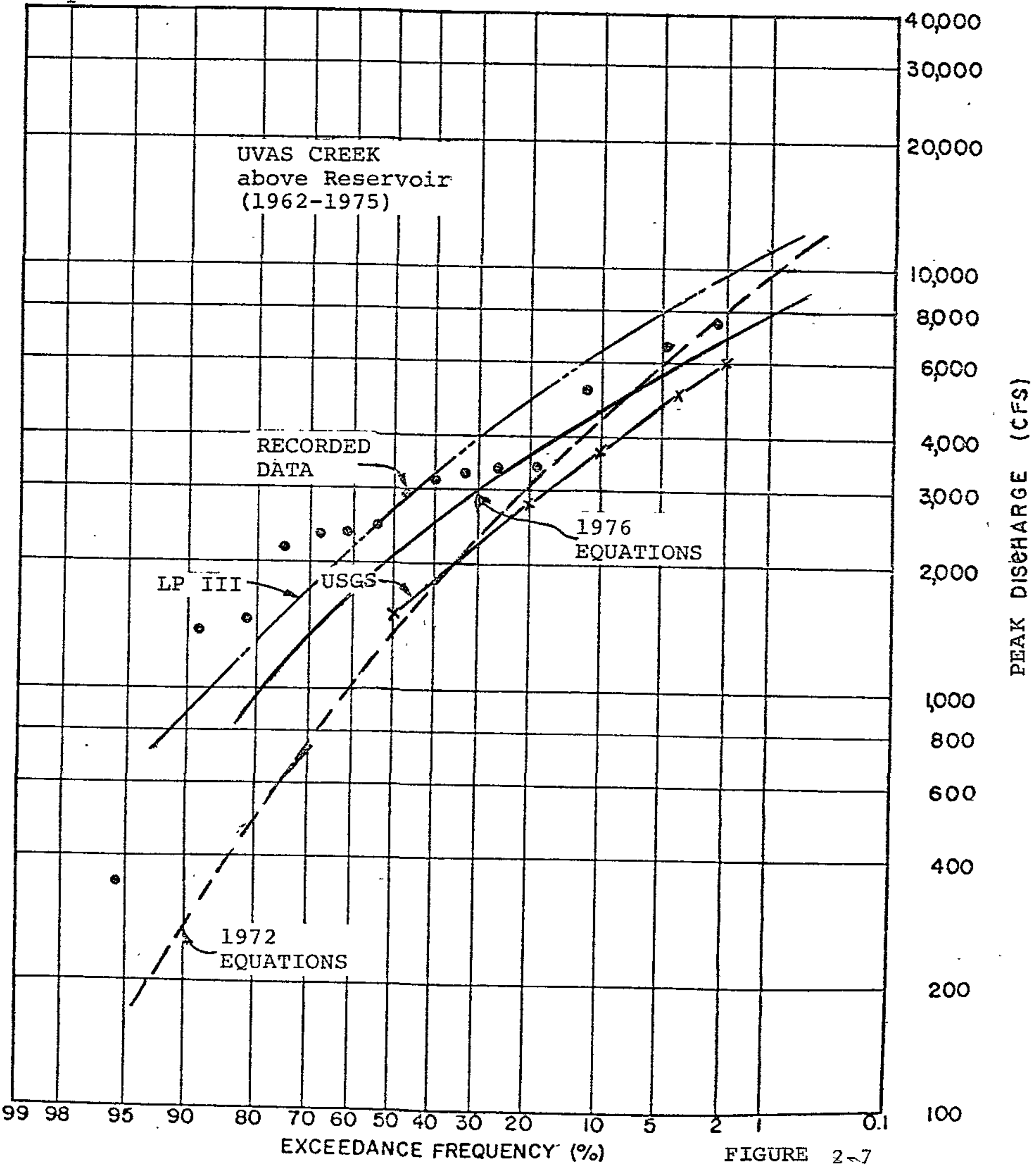


FIGURE 2-7

LP III Curve is from recorded and estimated Data.

September 1976

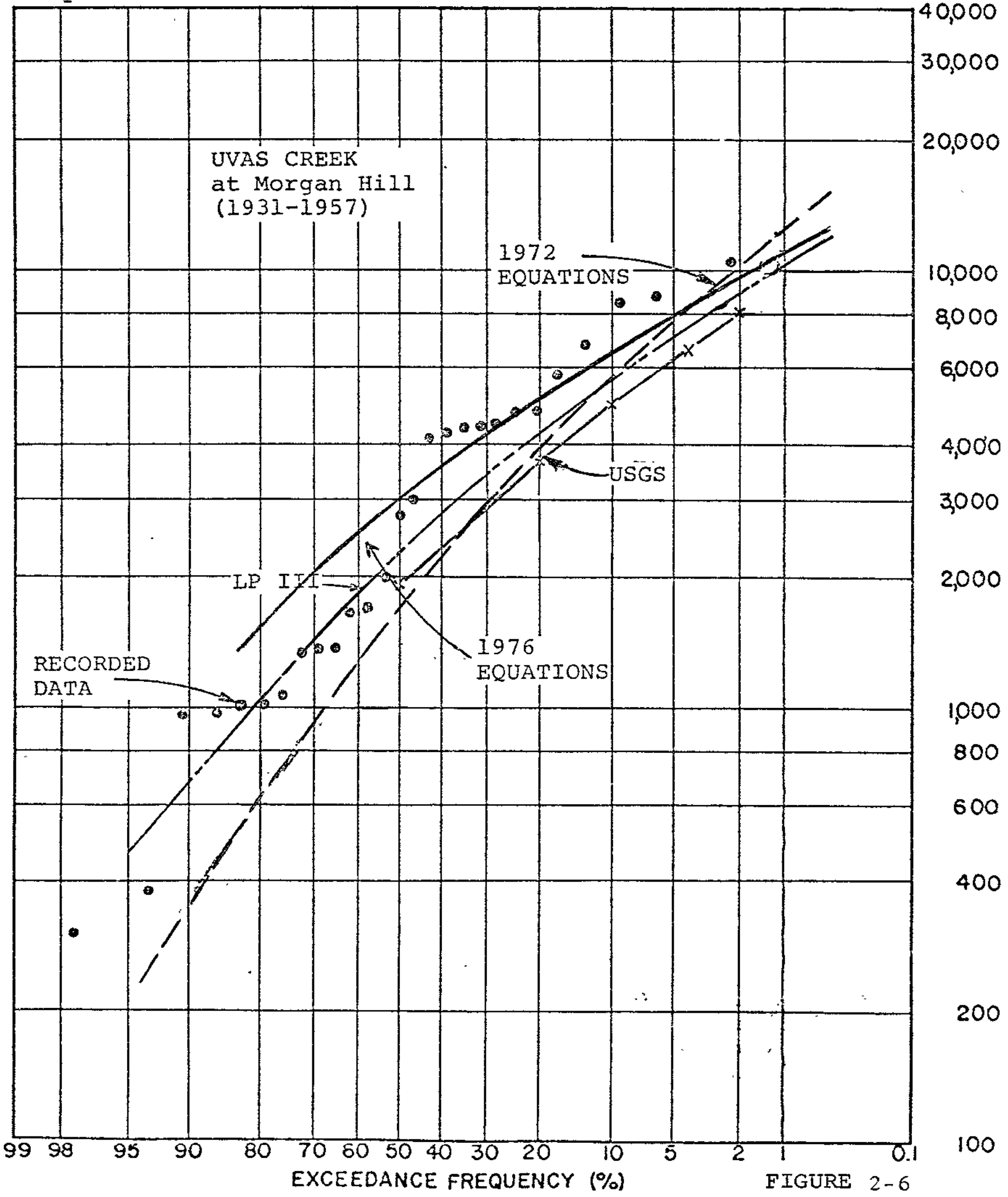


FIGURE 2-6

LP III Curve is from recorded and estimated Data.

September 1976

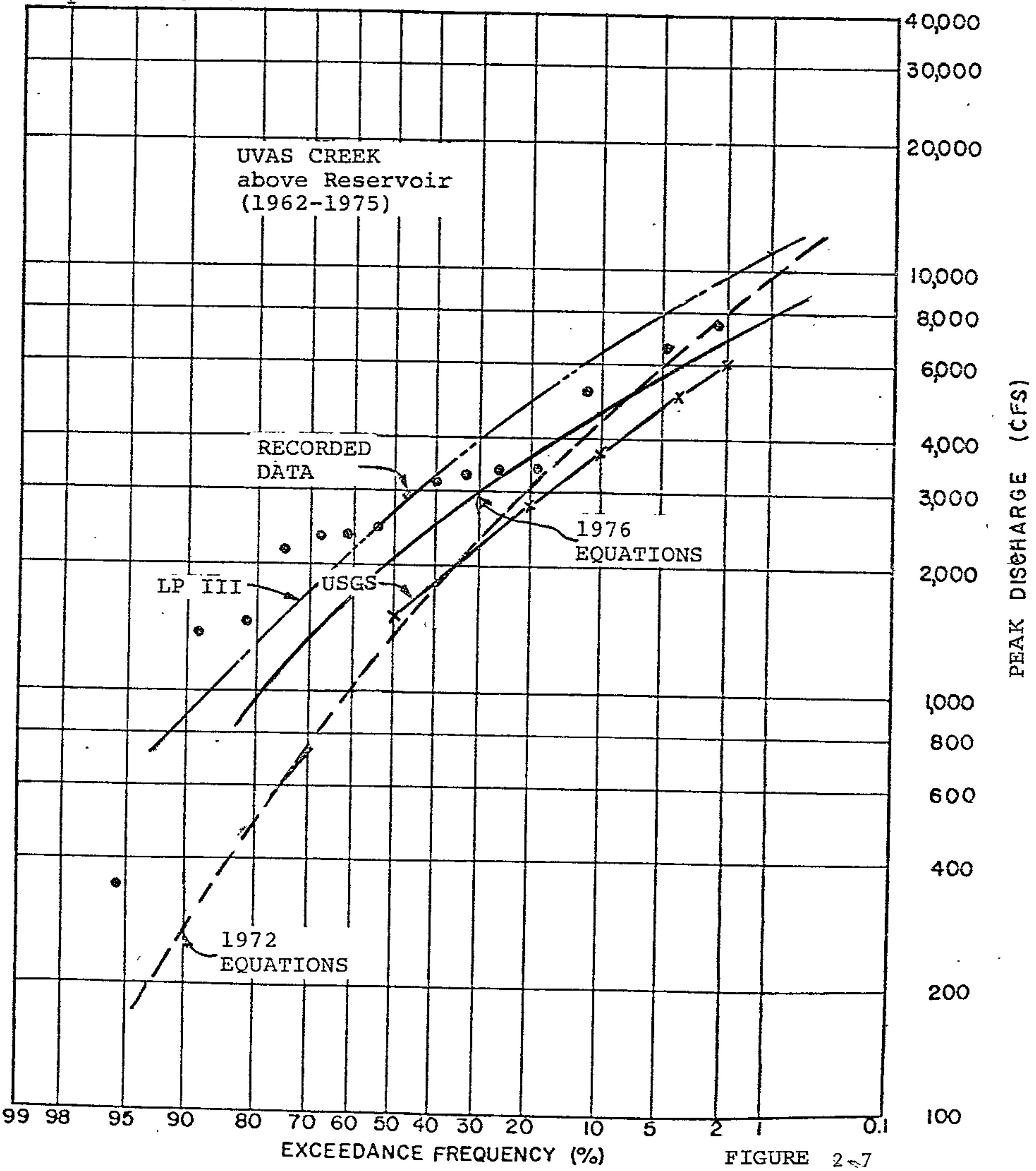


FIGURE 2-7

LP III Curve is from recorded and estimated Data.

September 1976

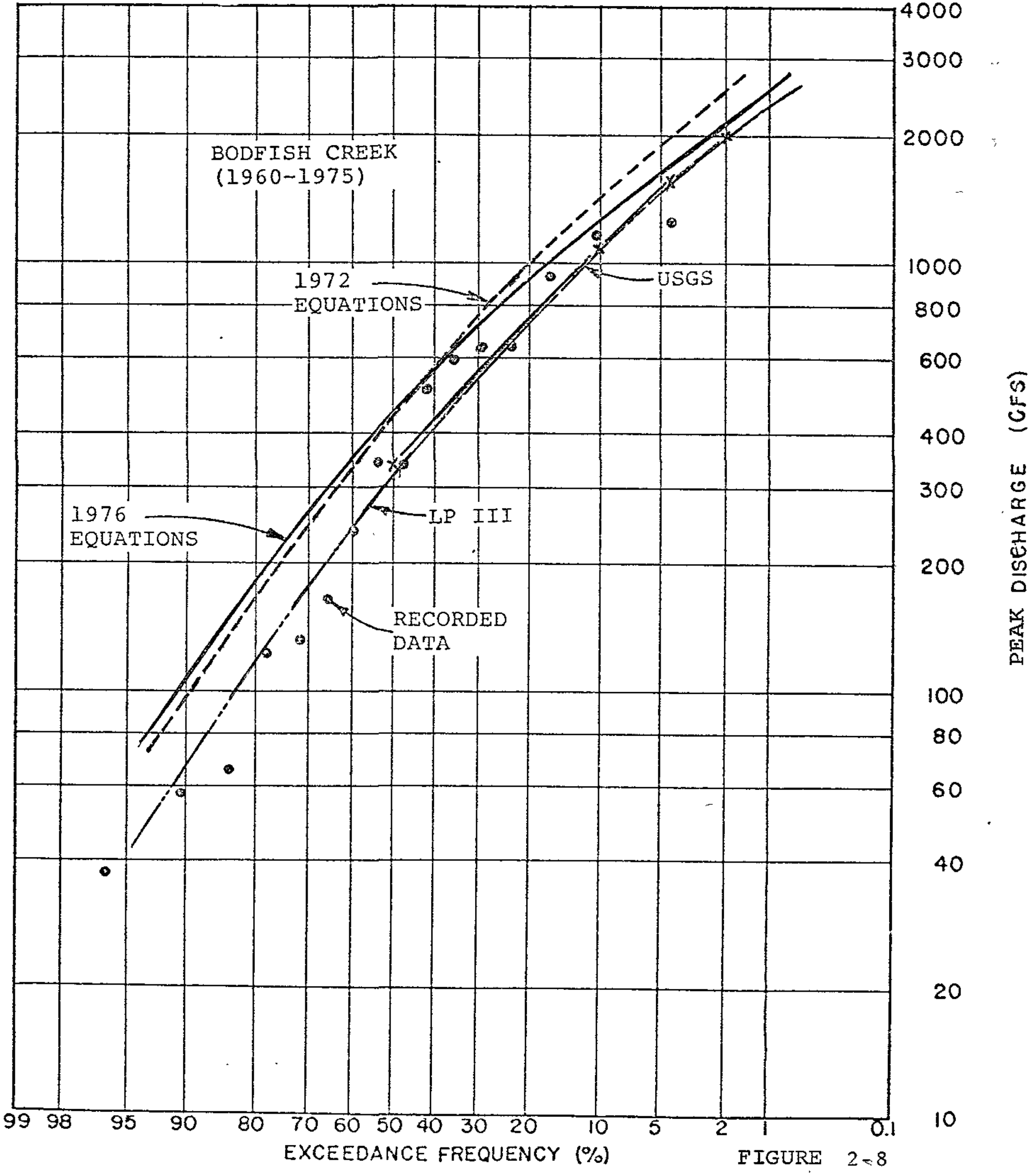


FIGURE 2-8

LP III Curve is from recorded and estimated Data.

CONCLUSIONS

This report is the summary of work completed in the study of the Uvas Creek Hydrology. The application of the 1976 Regional Equations results in favorable comparisons with streamgage analyses and compares quite favorably with flow values developed by previous studies from various agencies.

After careful consideration, it is recommended that the flows derived using the 1976 Regional Regression Equations and a coincident frequency reservoir level be used for design purposes.

The recommended one percent design flows are summarized in Table 2-5 along with the ten percent design flows in Table 2-6. The values in these tables should be rounded up to significant figures. A graphical representation of the frequency regime of Uvas Creek at Pajaro River is shown in Figure 2-9.

TABLE 2-4

COMPARATIVE 1% DESIGN FLOWS (CFS)

		---1977 SCVWD-----				1973		Recorded and
LOC/GAGE	(Sq.Mi.)	Recommended Coincidental	Full	SCVWD 1972	1971 Green Book	Corps of Eng. Full	Recorded Data n=Years of Record	Reconstituted Data
Uvas U/S Reservoir USGS #1539	21.0	7830	7830	9800	-	-	8960 n=14	10050
Uvas @ Morgan Hill USGS #1540	30.4	Inflow 11150 Outflow 7810	11150 9290	12400	-	10900 9400	13580 n=27	11090
Bodfish USGS #1541	7.4	2470	2470	3000	-	-	2200 n=16	2320
Little Arthur SCVWD #65	9.2	3360	3360	-	3400	-	3350 n=11	-
Uvas U/S Little Uvas	14.1	5490	5490	-	7300	-	-	-
Croy U/S Uvas	2.9	1380	1380	-	1850	-	-	-
Bodfish U/S Uvas	13.6	4280	4280	-	6000	-	-	-
Uvas D/S Little Arthur	46.7	10420	12650	-	-	13600	-	-
Uvas @ 101	71.6	14400	17200	-	-	17100	-	-
Uvas-Carnadero @ mouth	87.5	16250	19020	-	-	18900	-	-

TABLE 2-5

1977 SCVWD 1% DESIGN FLOWS
UVAS RESERVOIR, INCIDENTAL STORAGE
6800 Acre-Feet

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	1	4353.	3302.	1994.	986.	11.26	
ROUTED TO	1	4353.	3302.	1994.	986.	11.25	
HYDROGRAPH AT	4	1379.	909.	541.	266.	2.93	Croy Creek U/S Uvas Creek
ROUTED TO	4	1379.	909.	541.	266.	2.93	
ROUTED TO	1	1134.	894.	539.	266.	2.93	
2 COMBINED	1	5487.	4196.	2532.	1252.	14.19	Uvas Creek U/S Little Uvas Creek
ROUTED TO	3	5392.	4192.	2532.	1252.	14.19	
HYDROGRAPH AT	2	1530.	1010.	604.	298.	3.63	*Upper Little Uvas Creek*
ROUTED TO	2	1530.	1010.	604.	298.	3.63	
ROUTED TO	3	1249.	995.	602.	298.	3.63	
HYDROGRAPH AT	3	1499.	936.	556.	273.	3.53	
ROUTED TO	3	1499.	936.	556.	273.	3.53	
2 COMBINED	3	2658.	1922.	1156.	571.	7.16	
2 COMBINED	3	7825.	6115.	3688.	1823.	21.35	Uvas Creek @ USGS #1539
ROUTED TO	7	7863.	6109.	3688.	1823.	21.35	
HYDROGRAPH AT	7	1435.	853.	520.	263.	3.86	
ROUTED TO	7	1435.	853.	520.	263.	3.86	
2 COMBINED	7	8820.	6962.	4208.	2085.	25.21	
HYDROGRAPH AT	7	1650.	1090.	644.	315.	3.69	*Eastman Canyon at Uvas Reservoir*
ROUTED TO	7	1650.	1090.	644.	315.	3.69	
HYDROGRAPH AT	7	835.	487.	284.	138.	1.56	
ROUTED TO	7	835.	487.	284.	138.	1.56	
2 COMBINED	7	2485.	1575.	928.	453.	5.25	
2 COMBINED	7	11151.	8502.	5126.	2538.	30.45	Uvas Creek @ USGS #1540, *Reservoir Inflow*
ROUTED TO	7	7811.	6793.	3460.	1778.	30.46	*Reservoir Outflow*
ROUTED TO	8	7728.	6731.	3457.	1777.	30.45	
HYDROGRAPH AT	8	995.	592.	346.	168.	2.05	
ROUTED TO	8	995.	592.	346.	168.	2.05	
2 COMBINED	8	8074.	7057.	3662.	1945.	32.51	Uvas Creek @ Watsonville Road Bridge
ROUTED TO	9	7753.	6913.	3656.	1945.	32.51	
HYDROGRAPH AT	9	1953.	1260.	735.	360.	4.74	
ROUTED TO	9	1953.	1260.	735.	360.	4.74	
2 COMBINED	9	8585.	7718.	4158.	2305.	37.25	Uvas Creek U/S Little Arthur Creek
HYDROGRAPH AT	10	1795.	1202.	723.	356.	4.58	
ROUTED TO	10	1795.	1202.	723.	356.	4.58	
ROUTED TO	9	1496.	1186.	720.	356.	4.58	
HYDROGRAPH AT	9	1954.	1268.	754.	370.	4.88	
ROUTED TO	9	1954.	1268.	754.	370.	4.88	
2 COMBINED	9	3354.	2445.	1473.	726.	9.46	Little Arthur Creek @ SCVWD #65
2 COMBINED	9	10414.	9615.	5329.	3031.	46.71	Uvas Creek D/S Little Arthur Creek
ROUTED TO	11	10283.	9535.	5326.	3031.	46.71	
HYDROGRAPH AT	11	1474.	887.	526.	262.	3.63	
ROUTED TO	11	1474.	887.	526.	262.	3.63	
2 COMBINED	11	10945.	10254.	5792.	3293.	50.34	Uvas U/S Bodfish Creek
HYDROGRAPH AT	12	2469.	1711.	1016.	501.	7.32	Bodfish Creek @ USGS #1541
ROUTED TO	12	2469.	1711.	1016.	501.	7.32	
HYDROGRAPH AT	12	1151.	716.	417.	204.	2.83	Whitehurst Creek U/S Bodfish Creek
ROUTED TO	12	1151.	716.	417.	204.	2.83	
2 COMBINED	12	3436.	2426.	1432.	705.	10.15	
ROUTED TO	11	3024.	2393.	1427.	705.	10.15	
HYDROGRAPH AT	11	1420.	888.	515.	251.	3.46	
ROUTED TO	11	1420.	888.	515.	251.	3.46	
2 COMBINED	11	4273.	3271.	1939.	957.	13.61	Bodfish Creek U/S Uvas Creek

TABLE 2-5 (Continued)

ROUTED TO	11	1420.	888.	515.	251.	3.45	
2 COMBINED	11	4273.	3271.	1939.	957.	13.61	Bodfish Creek U/S Uvas Creek
2 COMBINED	11	13644.	13094.	7598.	4250.	63.95	Uvas Creek D/S Bodfish Creek
ROUTED TO	13	13412.	12840.	7576.	4250.	63.95	
HYDROGRAPH AT	13	1828.	1154.	668.	330.	5.11	
ROUTED TO	13	1828.	1154.	668.	330.	5.11	
2 COMBINED	13	14244.	13707.	8196.	4579.	69.05	Uvas Creek D/S Reservoir Canyon Creek
ROUTED TO	14	14094.	13491.	8172.	4579.	69.05	
HYDROGRAPH AT	14	1129.	647.	363.	176.	2.54	
ROUTED TO	14	1129.	647.	363.	176.	2.54	
2 COMBINED	14	14407.	13818.	8487.	4755.	71.60	Uvas Creek At U.S. Highway 101
ROUTED TO	16	14393.	13803.	8483.	4755.	71.60	
HYDROGRAPH AT	16	508.	318.	176.	85.	1.06	
ROUTED TO	16	509.	318.	176.	85.	1.05	
2 COMBINED	16	14545.	13975.	8636.	4840.	72.66	Uvas Creek @ SPRR Track
ROUTED TO	18	14287.	13681.	8596.	4839.	72.66	
HYDROGRAPH AT	18	1256.	697.	387.	188.	2.60	
ROUTED TO	18	1256.	697.	387.	188.	2.60	
2 COMBINED	18	14603.	14022.	8926.	5028.	75.26	
HYDROGRAPH AT	15	994.	566.	318.	155.	2.30	Gavilan Creek @ SPRR Track
ROUTED TO	15	994.	566.	318.	155.	2.30	
ROUTED TO	17	803.	561.	317.	155.	2.30	
HYDROGRAPH AT	17	2672.	1711.	982.	479.	6.39	Tar Creek U/S Carnadero Creek
ROUTED TO	17	2672.	1711.	982.	479.	6.39	
HYDROGRAPH AT	17	1379.	825.	475.	234.	3.55	Tick Creek U/S Carnadero Creek
ROUTED TO	17	1379.	825.	475.	234.	3.55	
2 COMBINED	17	3587.	2537.	1457.	713.	9.94	
2 COMBINED	17	4311.	3098.	1774.	867.	12.24	
ROUTED TO	18	4176.	3095.	1774.	867.	12.24	
2 COMBINED	18	16251.	15935.	10481.	5895.	87.50	Uvas-Carnadero Discharge to Pajaro River

TABLE 2-6

1977 SCVWD 10% DESIGN FLOWS
UVAS RESERVOIR, INCIDENTAL STORAGE
6950 Acre-Feet

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	1	2333.	2009.	1082.	528.	11.26	
ROUTED TO	1	2333.	2009.	1082.	528.	11.26	
HYDROGRAPH AT	4	802.	604.	314.	152.	2.93	Croy Creek U/S Uvas Creek
ROUTED TO	4	802.	604.	314.	152.	2.93	
ROUTED TO	1	734.	591.	313.	152.	2.93	
2 COMBINED	1	3067.	2600.	1395.	680.	14.19	Uvas Creek U/S Little Uvas Creek
ROUTED TO	3	3055.	2599.	1395.	680.	14.19	
HYDROGRAPH AT	2	859.	649.	339.	165.	3.63	Upper Little Uvas Creek
ROUTED TO	2	859.	649.	339.	165.	3.63	
ROUTED TO	3	785.	635.	338.	165.	3.63	
HYDROGRAPH AT	3	778.	573.	290.	141.	3.53	
ROUTED TO	3	778.	573.	290.	141.	3.53	
2 COMBINED	3	1561.	1203.	627.	306.	7.15	
2 COMBINED	3	4610.	3802.	2022.	986.	21.35	Uvas Creek @ USGS #1539
ROUTED TO	7	4602.	3799.	2022.	986.	21.35	
HYDROGRAPH AT	7	771.	541.	288.	143.	3.86	
ROUTED TO	7	771.	541.	288.	143.	3.86	
2 COMBINED	7	5259.	4339.	2310.	1129.	25.21	
HYDROGRAPH AT	7	906.	693.	356.	172.	3.69	Eastman Canyon at Uvas Reservoir
ROUTED TO	7	906.	693.	356.	172.	3.69	
HYDROGRAPH AT	7	455.	312.	155.	75.	1.56	
ROUTED TO	7	455.	312.	155.	75.	1.55	
2 COMBINED	7	1361.	1005.	511.	247.	5.25	
2 COMBINED	7	6610.	5312.	2817.	1376.	30.46	Uvas Creek @ USGS =1540, Reservoir Inflow
ROUTED TO	7	2482.	2374.	1211.	667.	30.46	Reservoir Outflow
ROUTED TO	8	2478.	2367.	1211.	667.	30.46	
HYDROGRAPH AT	8	531.	372.	185.	89.	2.05	
ROUTED TO	8	531.	372.	185.	89.	2.05	
2 COMBINED	8	2583.	2445.	1324.	756.	32.51	Uvas Creek @ Watsonville Road Bridge
ROUTED TO	9	2541.	2409.	1322.	756.	32.51	
HYDROGRAPH AT	9	973.	730.	369.	179.	4.74	
ROUTED TO	9	973.	730.	369.	179.	4.74	
2 COMBINED	9	2805.	2627.	1601.	935.	37.25	Uvas Creek U/S Little Arthur Creek
HYDROGRAPH AT	10	989.	771.	399.	194.	4.58	
ROUTED TO	10	989.	771.	399.	194.	4.58	
ROUTED TO	9	932.	755.	398.	194.	4.58	
HYDROGRAPH AT	9	999.	765.	389.	189.	4.88	
ROUTED TO	9	999.	765.	389.	199.	4.88	
2 COMBINED	9	1931.	1514.	786.	383.	9.46	Little Arthur Creek @ SCVWD =65
2 COMBINED	9	3567.	3471.	2278.	1317.	46.71	Uvas Creek D/S Little Arthur Creek
ROUTED TO	11	3523.	3450.	2276.	1317.	46.71	
HYDROGRAPH AT	11	720.	505.	260.	128.	3.63	
ROUTED TO	11	720.	505.	260.	128.	3.63	
2 COMBINED	11	4110.	3973.	2515.	1445.	50.34	Uvas U/S Bodfish Creek
HYDROGRAPH AT	12	1268.	1005.	522.	254.	7.32	Bodfish Creek @ USGS =1541
ROUTED TO	12	1268.	1005.	522.	254.	7.32	
HYDROGRAPH AT	12	612.	440.	222.	108.	2.83	Whitehurst Creek U/S Bodfish Creek
ROUTED TO	12	612.	440.	222.	108.	2.83	
2 COMBINED	12	1878.	1444.	744.	362.	10.15	
ROUTED TO	11	1767.	1417.	742.	362.	10.15	
HYDROGRAPH AT	11	721.	525.	263.	127.	3.46	
ROUTED TO	11	721.	525.	263.	127.	3.46	
2 COMBINED	11	2480.	1934.	1004.	489.	13.61	Bodfish Creek U/S Uvas Creek

TABLE 2-6 (Continued)

HYDROGRAPH AT	11	721.	525.	263.	127.	3.46	
ROUTED TO	11	721.	525.	263.	127.	3.46	
2 COMBINED	11	2480.	1934.	1004.	489.	13.61	Bodfish Creek U/S Uvas Creek
2 COMBINED	11	6564.	5644.	3456.	1934.	63.95	Uvas Creek D/S Bodfish Creek
ROUTED TO	13	6177.	5556.	3446.	1933.	63.95	
HYDROGRAPH AT	13	860.	630.	318.	155.	5.11	
ROUTED TO	13	860.	630.	318.	155.	5.11	
2 COMBINED	13	6846.	6095.	3742.	2088.	69.06	Uvas Creek D/S Reservoir Canyon Creek
ROUTED TO	14	6556.	5996.	3732.	2088.	69.05	
HYDROGRAPH AT	14	512.	348.	167.	81.	2.54	
ROUTED TO	14	512.	348.	167.	81.	2.54	
2 COMBINED	14	6780.	6212.	3880.	2168.	71.60	Uvas Creek At U.S. Highway 101
ROUTED TO	16	6763.	6202.	3879.	2168.	71.60	
HYDROGRAPH AT	16	239.	164.	77.	37.	1.06	
ROUTED TO	16	239.	164.	77.	37.	1.06	
2 COMBINED	16	6864.	6313.	3947.	2205.	72.65	Uvas Creek @ SPRR Track
ROUTED TO	18	6578.	6165.	3929.	2205.	72.65	
HYDROGRAPH AT	18	527.	348.	166.	80.	2.60	
ROUTED TO	18	527.	348.	166.	80.	2.60	
2 COMBINED	18	6782.	6372.	4074.	2285.	75.25	
HYDROGRAPH AT	15	460.	310.	149.	72.	2.30	Gavilan Creek @ SPRR Track
ROUTED TO	15	460.	310.	149.	72.	2.30	
ROUTED TO	17	431.	306.	149.	72.	2.30	
HYDROGRAPH AT	17	1199.	921.	450.	217.	6.39	Tar Creek U/S Carnadero Creek
ROUTED TO	17	1199.	921.	450.	217.	6.39	
HYDROGRAPH AT	17	644.	447.	224.	109.	3.55	Tick Creek U/S Carnadero Creek
ROUTED TO	17	644.	447.	224.	109.	3.55	
2 COMBINED	17	1828.	1368.	674.	326.	9.94	
2 COMBINED	17	2239.	1674.	823.	398.	12.24	
ROUTED TO	18	2263.	1673.	823.	398.	12.24	
2 COMBINED	18	8214.	7614.	4806.	2683.	87.50	Uvas-Carnadero Discharge to Pajaro River

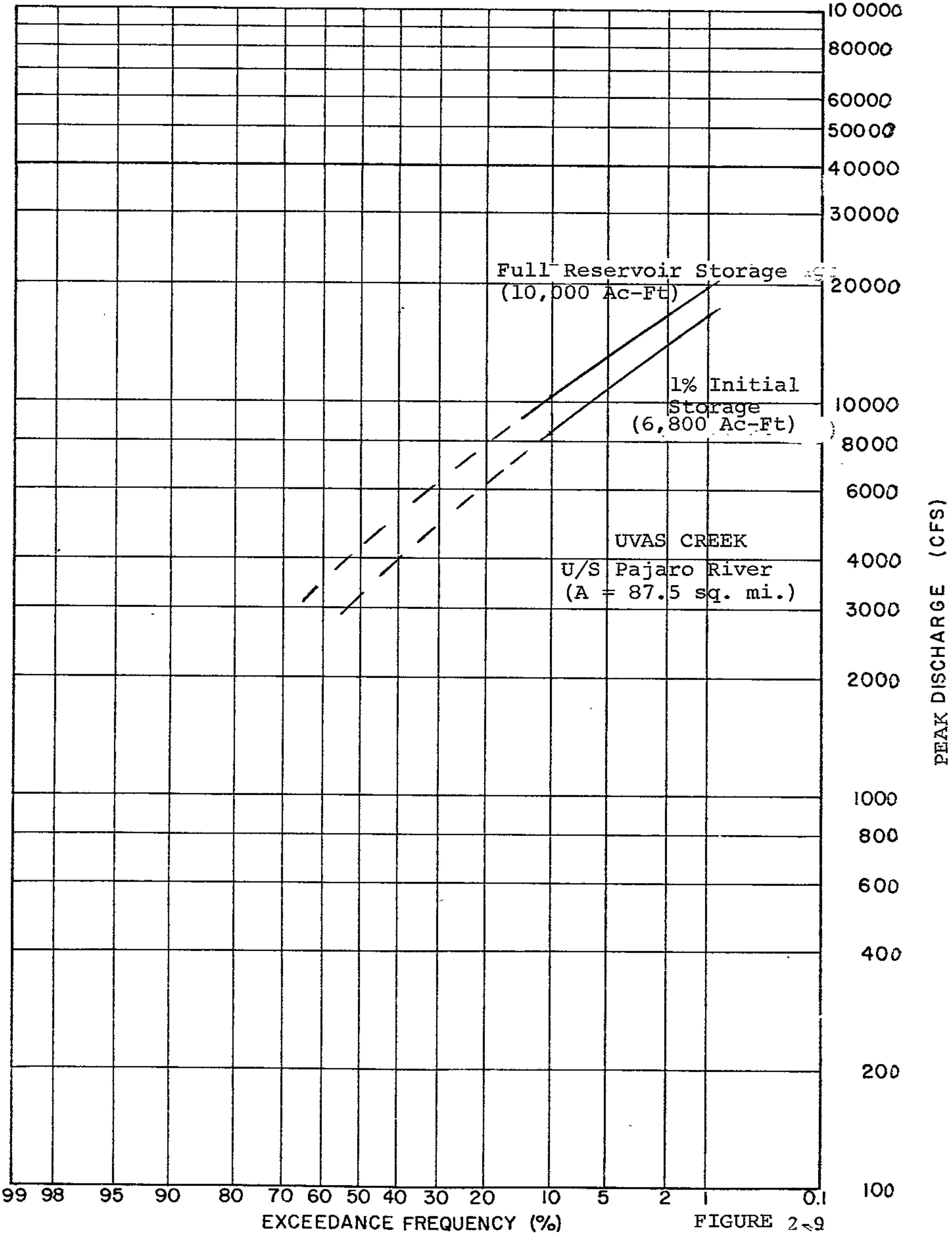

Full Reservoir Storage
(10,000 Ac-Ft)
1% Initial Storage
(6,800 Ac-Ft)
UVAS CREEK
U/S Pajaro River
(A = 87.5 sq. mi.)
10 0000
80000
60000
50000
40000
30000
20000
10000
8000
6000
4000
3000
2000
1000
800
600
400
200
100
PEAK DISCHARGE (CFS)
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.1
EXCEEDANCE FREQUENCY (%)

FIGURE 2-9

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